To shoot with a cine camera is no more difficult than taking a snapshot. But making a film—that is a different story.

Making a film that is good enough to please others requires discriminate choice of cine equipment, continuity of technique and purposeful approach to its subject matter. Making a good film isn't magic and it isn't a science either, but it does need some knowledge and a little common sense. You will find all that in this book.

First things first—it tells you about the principles that make a movie move.

It then describes how to manipulate the cine camera and how to get technically satisfactory results.

Proceeding from the single shot to the story-telling sequence it leads you step by step into the anatomy of movie making.

Going into technical details it classifies, compares and explains films, filters, and exposure meters and other accessory equipment.

It devotes, of course, a special chapter to colour.

It deals not only with filming outdoors but also indoors both in terms of equipment and method.

It covers the production of titles, the use of tricks and of special effects.

It has chapters on the art of film editing, the technique of projection and the novel applications of sound.

It has a wealth of tables on faults and their remedies and an exceptionally comprehensive glossary both of the technical and colloquial terms used in film making.

THE COMPLETE TECHNIQUE
OF MAKING FILMS

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The COMPLETE TECHNIQUE *of* MAKING FILMS

by

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Introduction

IF YOU HAVE a cine camera, you will be anxious to get down to making films without delay. But before you do so, you need to know something of the fundamentals of cinematography.

If you do not yet own a camera or projector, you will have to decide on one and on which gauge of film to use. Once you have made your choice, it is at least inconvenient, and may be expensive, to go back on it. Parts of this book are designed to assist you in selecting the camera and gauge that suit your needs.

This book does not tell you how to load your camera, nor where the release button and the other controls are; these depend on the design of the camera, and the instruction book is there for that. If you have not got an instruction book, the manufacturer, or your dealer, can probably help. Full details on specific camera makes are also given in Focal Press Camera Guides.

What we have attempted to do is to tell you *what* to film, *when* to film it, and *how* to do it.

How Motion Pictures Move

IF YOU ARE ACCUSTOMED to using a still camera, you will need a different approach to picture-making when it comes to cinematography. And the better you understand how to tell stories in moving pictures, the better your films will be and the greater the pleasure that they will give.

Let us start then with a bird's eye view of the essentials of movie-making; later we can fill in the details. We hope in this way to offer a short cut to successful movies.

Reproducing Movement

A still and a cine camera have much in common. The optical design is similar in both, as are the chemical processes that the film undergoes during and after exposure. A still camera records a single exposure of a subject in a particular attitude; a cine camera takes a succession of still pictures or frames at brief and regular intervals.

The film must come to rest momentarily to enable the camera to record the individual images, and this normally happens sixteen times each second.

You may ask how a series of isolated images of continuous movement can reproduce movement in its entirety on the cinema screen. Most movements, whether of long or short duration, are continuous, whereas cine film moves intermittently in both camera and projector to reproduce motion.

The sequence of operations is perhaps easier to understand if we consider how cine film runs through the projector. Each one of the long sequence of images contained in a complete scene remains stationary behind the projector lens for an

instant, during which it is projected on the screen. It is then pulled down rapidly by the film transport mechanism and the next image takes its place. The movement of the film is obscured from the audience by a *shutter* which is timed to reopen when the next image is stationary behind the lens ready to be projected. This is a very simplified description of a rather complicated mechanism, but indicates what in effect happens.

We thus have on the screen a rapid succession of images alternating with dark periods. As the retina of the human eye retains impressions for a fraction of a second, each new image does not immediately fade, but is superimposed on the preceding one. In this way static images, when projected for a fraction of a second at very brief intervals, give a perfect illusion of continuous movement.

Broadly speaking the same cycle of operations takes place in the camera, too. Thus in the camera the film comes to rest behind the lens, the shutter opens to admit the light, the image is recorded, the shutter closes, and the film is moved on one frame. All that takes place again sixteen times a second.

In this way, the whole sequence of a movement is recorded as a series of still pictures on the strip of film.

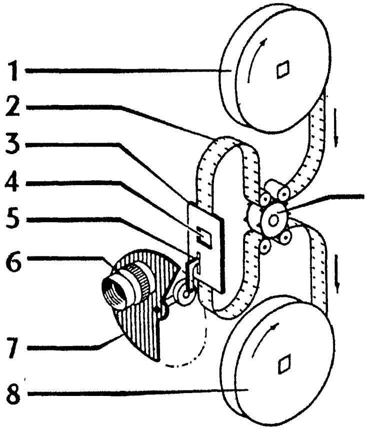
Cine Film Types

The sensitive material used in filming is closely related to other photographic films in principle.

The professional movie-maker in fact uses *negative film* in his camera, from which *positive prints* are then made for projection, just as prints are made of black-and-white snapshots. The main difference is that the strip of images of a motion picture print is made on a transparent film base, and not on paper.

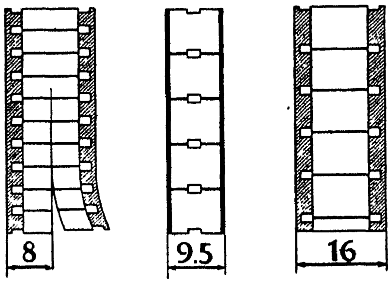
But as an alternative, amateur cinematographers can use the same actual strip of film for both shooting and viewing by projection, which is much more economical. This is possible by the use of a special *reversal emulsion* which is developed to give a direct positive image, instead of a negative.

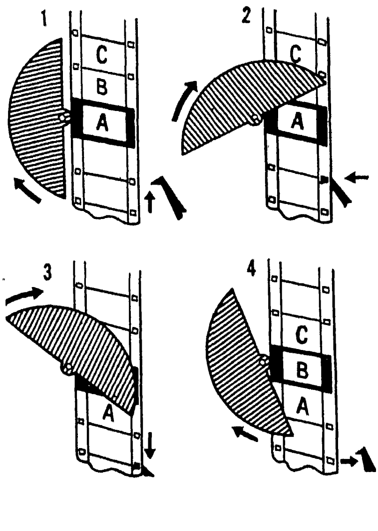
Films of this reversal type are available for both black-and-white and colour filming in all the three gauges or sizes (page 15). Various emulsions are supplied for filming under the



Left: Film transport in the camera. 1. Feed spool. 2. Upper film loop. 3. Gate. 4. Aperture. 5. Claw. 6. Lens. 7. Rotary shutter. 8. Take-up spool. 9. Sprocket. The claw, 5, shutter 6, and sprocket 9 are geared together. The claw advances the film while the shutter is closed. When the shutter opens the film comes to rest momentarily in the gate. The film is driven continuously by the sprocket 9, so the upper loop 2 and the corresponding lower loop must be large enough to permit the film to move *intermittently* through the gate.

Right: Sub-standard film gauges compared. The illustrations are smaller than actual size, but in the correct relative proportions. Most 8 mm. cameras take double-8 film, which is 16 mm. wide before exposure. The picture aperture of such cameras extends over half the width of the film only, which is run twice through the camera, processed, then split longitudinally for projection.





Left: The film transport works together with the shutter. 1. Frame A is exposed in the gate. 2. Claw engages film perforation, shutter starts to close. 3, light is cut off, claw pulls down film. 4. Shutter uncovers frame B as claw disengages film.

This cycle of operations takes place 16 times per second with the camera running at the normal speed for silent films. The result is a series of still pictures, each of which records a different phase of movement in the original subject. After processing, these pictures are projected in rapid succession on the screen, where they blend into a continuous image and reproduce an illusion of the original movement.

most varied conditions both by daylight and artificial light.

The purchase price of reversal film usually covers the cost of processing, so that it is only necessary to hand the exposed film to a photo dealer or post it direct to the manufacturer's processing laboratory, and it will be returned ready for projection without further charge.

Home processing of black-and-white reversal film is not beyond the ability of the advanced amateur, though particular care is required to obtain satisfactory results. Colour film, however, is quite another story; only the film manufacturer himself or specialized laboratories are equipped to handle it.

An advantage of laboratory processing of black-and-white film is that special machinery is available to provide a considerable degree of compensation for exposure errors. This has an obvious appeal to the beginner in cinematography, whose main concern is to get the exposure right.

All modern black-and-white emulsions are of the *panchromatic* or "pan" type, which means that they are about equally sensitive to all visible colours. Films are nowadays made in a range of *speeds* or general sensitivities; this makes filming possible under a wide variety of conditions.

When darkness falls, there is no need to put the camera away. If it is loaded with fast film, you can shoot illuminated street signs, firework displays, camp fires, to mention only three possibilities.

Colour Film

Besides black-and-white film, the amateur can also use colour film in any gauge. The attraction of natural colour needs no stressing; and now that colour film is available almost everywhere, many workers have entirely given up using black-and-white film. On a bright sunny day, when the subject faces the light, colour filming presents no difficulty at all, and the simple exposure guide enclosed with the film is quite reliable. But where conditions are not straightforward, for instance with part of the scene in deep shadow, or when shooting against the light, colour film has much less latitude than black-and-white in dealing with exposure errors.

Film Gauges

Three gauges of film are available for amateur use: 8 mm., 9.5 mm., and 16 mm. This is the actual width of the film as it runs through the projector. All three gauges have sprocket holes or perforations along their length; the driving sprockets and claws of camera or projector engage in these to transport the film. The type of perforation varies with the gauge.

The choice will depend on a number of factors, the relative importance of which is largely a personal matter. The smaller the gauge, the cheaper the running cost; the larger, the nearer the quality approaches the standard of professional film-makers.

But as small gauge apparatus has to be made with great precision, its first cost can be considerable. Unlike still work which needs only a camera, movie-making calls for both camera and projector; and the cost is, very roughly, the same for each. If you start filming on one gauge and later decide to change to another, you may run into unexpected expense. Unless you buy a dual-gauge projector you will still need the old projector to project old films.

Mechanical Principles

As explained, the camera must transport the film intermittently so that at least sixteen pictures per second are exposed.

Inside the camera the film is loaded by *spool* or a special *magazine*. It passes into the gate, or picture aperture, where a pressure plate bears on it from behind, keeping it absolutely flat. A claw mechanism is synchronized with the shutter movement so that when the film comes to rest, the shutter opens and the lens forms an image on it. As the shutter closes, the claw engages the film and advances it by one picture. The process of uncovering the lens and advancing the film goes on alternately —so fast as to seem continuous—for as long as the release button is pressed.

The film emerges from the gate and is threaded over a sprocket which feeds it to the take-up spool (or chamber in the magazine). Here it is stored safely until removal for processing.

Advanced cameras are fitted with a sprocket wheel on both

sides of the gate; sometimes a single sprocket does duty for both.

In addition to this basic mechanism, most cameras incorporate a number of additional features. A viewfinder for sighting and composing the picture is essential; so also is a footage counter to show how much film has been used. Refinements may include variable filming speeds for special effects, backwinding, a turret head for holding two, three, or four lenses, visual focusing and so on.

Nearly all 8 mm., 9.5 mm. and 16 mm. cameras are operated by clockwork. Just a few models do exist, especially expensive professional 16 mm. cameras, that run on an electric motor.

Projectors follow a similar pattern to the basic mechanism of the camera. Behind the gate, a powerful lighting system is fitted so that the lens in front will project an image on to any suitable screen. In place of the smaller 50-foot or 100-foot spools, a projector may take spools holding up to 2,000 feet of film so that a long film can be projected without interruption.

Adding Sound

Sound has become an indispensable adjunct to films of all types, from the simple family record (where commentary and/or background music are adequate) to professional and semi-professional productions (where *synchronized* dialogue may be needed).

Simultaneous recording of picture and sound in accurate synchronization calls for precision-built apparatus which is only available for the 16 mm. gauge, and anyway is beyond the means of the average amateur. If you are planning a film with dialogue in which you require lip synchronization, it is best to have the dialogue *post-synchronized*; that is to say, add the sound after the film has been shot, processed and edited. This can be done either by adding an *optical* or *magnetic sound track* to the film itself, or recording the sound on separate magnetic tape and synchronizing the sound reproducer and projector.

The first, and initially more complicated method, applies only to 16 mm. film and exactly follows the procedure with professional 35 mm. films. An optical sound track consists of a narrow band of varying density (representing the sound fre-

quencies) and is recorded and printed along one edge of the film in place of one row of perforations. It does not encroach in any way on the picture. Library sound films in the 9.5 mm. gauge also have the sound track printed on one side of the film, but there are no facilities for direct recording of sound on film in this gauge.

Sound films of this type have to be projected in a sound projector, which is considerably more expensive than a silent machine, but not much more complicated to operate. Many sound projectors can also be used to project silent films.

The main advantage of an optical sound track is that the film can be projected on almost any sound projector, and once the sound and picture are incorporated on one strip of film, they cannot get out of synchronization. The main disadvantage is the high initial cost: amongst other things, the film must run through camera and projector at twenty-four frames per second, i.e. 50 per cent faster than for normal silent films.

An alternative method of adding a sound track to the actual strip of film that runs through the projector is to record the sound magnetically. This is done on a special iron oxide coating which can be applied to the edge of a film after it has been processed and edited.

Magnetic striping, as it is called, is easier and cheaper than optical recording, and will give better quality sound at a given running speed; but it has the disadvantage that projectors able to reproduce magnetic sound are still in the minority, and are more expensive than models designed to reproduce optical sound only.

Magnetic sound is most widely used for 16 mm. films and can be usually recorded with the same projectors on which playback is possible. A single film can have separate optical and magnetic tracks, in different languages if desired.

Several projector attachments are also available for recording on magnetic tracks with a silent projector; many of these are for 8 mm. and 9.5 mm.

Devices are also now available which enable a projector and normal domestic tape recorder to be synchronized. As a refinement special tape recorders are even manufactured for mechanical coupling to specific projectors. A commentary can

be recorded after the film has been edited, and then played back in synchronism with the film.

But synchronization of motion picture film with a normal tape recording can only be approximate, as the tape stretches or contracts according to atmospheric conditions; also tape is driven by friction, whereas the film is sprocket driven.

For perfect synchronization (e.g. dialogue) perforated film, coated completely with the recording medium, is used in special recorders that are operated in conjunction with the picture film. For playback purposes the recording is transferred to an optical track on the completed film. Basically, this system is the same as magnetic striping on the picture film, but having the sound on separate film to start with offers certain advantages in preparing the finished track.

Handling the Camera

Basically, taking motion pictures does not demand a great deal of technical knowledge, but a few principles are important to know before starting. They concern in particular the loading of the camera and setting of the controls, as well as the approach to recording action as movement, as distinct from producing static pictures.

What Film

For the first filming venture choose a medium speed black-and-white reversal film, i.e. one of average sensitivity. This will usually be marked 27–28°BS or 40–50 ASA (see page 62) and is the best all-round material, providing a most suitable compromise of the various properties of different types of film material.

The film will of course be panchromatic, recording all colours more or less evenly, without exaggerated brightness at the blue end, or darkness at the red end of the spectrum.

For very bright subjects a slower film of 24–25°BS or even 22°BS can be used, while in poor light a fast film of 30–31°BS is more useful.

On the other hand, if you want to start straight away with colour film, it matters less which make you choose. It is, however, important to start with one type (a daylight colour film—for outdoor work) and stick to it until its characteristics have become really familiar. Chopping and changing from one make to another is bad, for you never get to know just what the film is capable of tackling, and when the results are definitely wrong.

The instruction book of the camera will give full details of the exact loading procedure. Basically all that is involved is opening the side or back of the camera, and—if it is a *spool*-loading camera—placing the spooled film on the feed spindle. The film is laced through the path indicated by the instructions (and often marked inside the camera too); it is then attached to an empty spool on to which it will be wound. *Magazine-loading* cameras are even more simple to load: the complete magazine is simply placed in position in the camera.

If your camera accepts spools, load in subdued light. Outdoors on a bright day go into the shade, or if none is available at least turn your back to the sun. Remember that the lighter, matt side of the film, which carries the emulsion coating, must always face the lens.

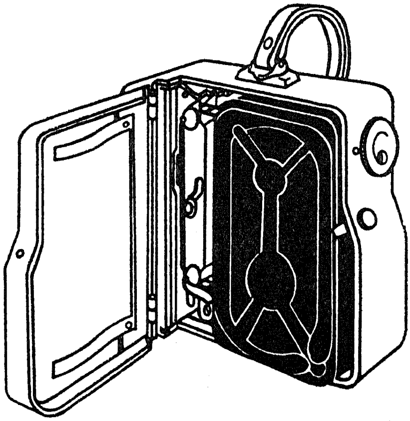
With a spool-loading camera (unless fitted with automatic loading guides) take care to form loops of the correct size above and below the gate. They must neither be too small (which interferes with the intermittent movement) nor too large (they would chafe against the spool chamber).

With a magazine-loading camera, make sure before closing the film chamber that the gate pressure-plate is pushed home.

With all cameras it is advisable to check the mechanism by running the camera for 2 to 3 seconds after loading, before closing the door.

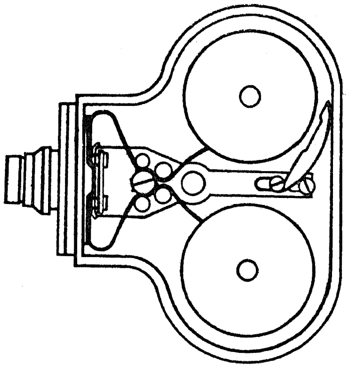
Most 8 mm. film cameras are designed for what is known as *double-run* 8 mm. film. This is a 16 mm. wide film that is exposed down one half only, then reloaded and exposed down the other half. After processing it is split to provide double the length of 8 mm. film.

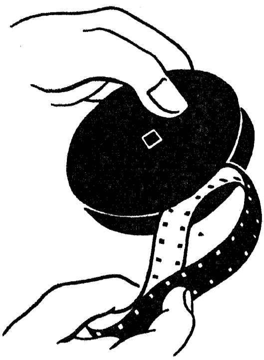
With double-run cameras the take-up spool is distinctly marked to indicate that the film has to run through twice. There will be an inscription such as "Film on this spool is only half exposed", or "1/2 EXP", or Roman numerals I and II on the flanges. Never part with the take-up spool of a double-eight camera, nor if it is lost replace it with an unmarked one. To do so will be an inevitable source of errors involving wasted or double-exposed film.



Left: Most 9.5 mm. cameras accept film in 30 ft. chargers. To load the camera, open the door, withdraw the pressure plate, insert the charger, thread the film through the gate, reset the pressure plate in position, and close the camera door.

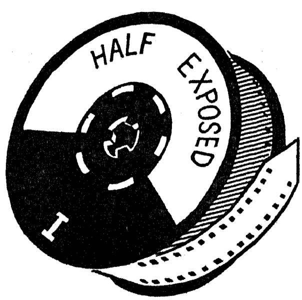
Right: Film path of a spool-loading camera. It goes from the upper (feed) spool, over the sprocket, through the gate, underneath the sprocket, and on to the lower (take-up) spool.





Left: Buckled spool flanges can cause the mechanism to jam and ruin your film. A good way of testing the flanges is to use a loop of film as a distance gauge. Never try to straighten a bent spool; discard it.

Right: 8 mm. film is usually supplied on 25 ft. daylight loading spools, which are run twice through the camera. Camera take-up spools are distinctively marked to indicate when the film has completed its first run only.



When reloading a double-eight film for the second run, take the same precautions against daylight as for the original loading. Carelessness will fog a considerable length in the middle. Opening the spool chamber of a double-eight spool-loading camera in the middle of a run will fog not only the shots previously filmed, but the other side of the film as well.

When using the camera away from home it is a good idea to carry a spare take-up spool. If a spool becomes damaged—and it only needs a slight dent in one flange to cause the camera to jam—it can then be replaced on the spot.

On most cameras there is a footage counter which is automatically reset to zero on loading a new spool or magazine; but where this is not the case it is important to remember to set the counter by hand.

Spools of film are always supplied with an additional length of film over and above the nominal length of 25, 50 or 100 feet. It is generally 4 or 5 feet long, protects the film proper from fogging, and is removed after processing. The length of leader is usually indicated by a distinctive mark on the footage counter. Do not therefore start shooting until this mark appears.

Unloading

Before opening the camera at the end of a reel check the footage counter to make sure that the film is finished. If in doubt, and the camera has a detachable lens, unscrew it and run the mechanism briefly to observe whether any film is still in the gate. You can usually tell when the film has passed right through on to the take-up spool by listening for a slight change of pitch in the motor, and the sudden cessation of the distinctive "flutter" of the intermittent mechanism.

For obvious reasons it is inadvisable to shoot an important scene near the end of a reel; the film may run out before the scene is finished. So it is best to finish the reel on something that can be repeated if required, such as a title.

Movie-makers are sometimes surprised, when a reel comes back from the laboratory, at the absence of scenes which they

clearly remember filming. While magazines have no blank leader like spools, it must be realized that the actual strip outside the light-tight chamber is fogged and therefore cannot be used for filming. And the leader strips at each end of spooled film are generally cut off at the laboratory after the film has been processed.

Always remove the spool or magazine from the camera in subdued light. With spools, hold the end of the film tight to prevent uncoiling, but do not pull the end taut as this will cause scratches.

To secure the film either use a short length of adhesive tape, or moisten the end and press it down on the next coil until it adheres firmly.

In the case of half-exposed double-run 8 mm. film, reload for the second run.

When packing films for dispatch to the laboratory, always use the manufacturer's original wrapping and metal container. If these are not available it is most important to indicate clearly the make and type of film and whether it is a black-and-white or colour emulsion. If the film is damaged in any way, or is shorter than the standard length, the fact should be clearly indicated on the package. Some laboratories reserve the right to refuse to handle films not returned intact and in their original containers.

Lastly, and most important, write your name and address clearly on each package. It is the only way the laboratories have of identifying your films—every year hundreds of films go astray only because the owner cannot be traced for lack of proper labelling.

The Lens

The lens normally fitted to the camera takes in a horizontal angle of view of about 22 degrees. Under average conditions of projection, a shot taken with this so-called *standard lens* shows the scene on the screen more or less as the eye in fact sees it.

The angle of view is governed by the *focal length* of the lens and by the film gauge. The different film gauges thus correspond to different standard focal lengths of lens.

Gauge	*Standard Focal Length*	
	in.	mm.
8 mm.	$\frac{1}{2}$	12–13
9.5 mm.	$\frac{3}{4}$–1	20–25
16 mm.	1	25

Lenses generally have the focal length engraved on the mount, the symbol being "f" followed by the length, usually in millimetres. This should not be confused with the *f*-numbers of the aperture scale.

Lens Apertures

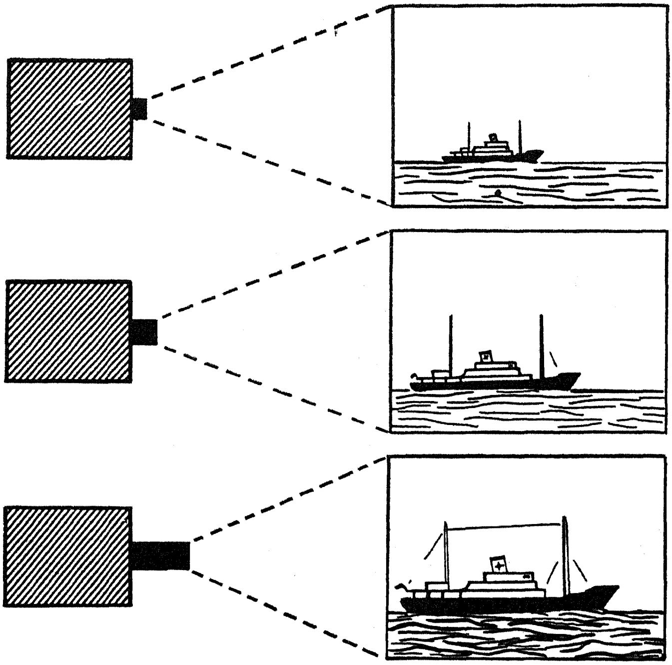
All camera lenses are fitted with an adjustable aperture which controls the amount of light admitted to the film. On most cameras it consists of an iris diaphragm which is operated by moving a ring on the outside of the mount. At its maximum opening—which may be marked 2.8, 1.9 or 1.5, according to the lens—it allows a great deal of light to pass; closed right down—to 11, 16 or 22, very little light is admitted.

The *f*-number indicates the ratio of the focal length to the diameter of the aperture. Thus at *f*8 the aperture is 1/8 of the focal length, at *f*4 it is 1/4 and so on. It follows that the *smaller* the *f* number, the *larger* the aperture. The amount of light passed by the diaphragm depends on the *area* of the aperture, or the *square* of the *f*-number. This means that at *f*4 *four times* more light is admitted than at *f*8.

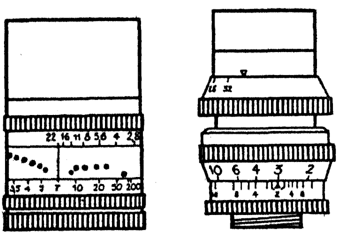
A standard range is generally employed: 1.4 (or 1.5)—2 (or 1.9)—2.8 (or 2.7)—4—5.6—8—11—16—22. This has the merit that going from one step to the next (one number to the next *higher* one) halves the amount of light passed through. The larger apertures are normally only available on more expensive lenses.

These figures or *f*-numbers are also known as *stops*. The expression "to stop down" means to use a *smaller* aperture, i.e. a *larger f*-number.

The converse is "to open up" the aperture by so many stops in the above series.



The focal length of the camera lens governs the angle of view and the scale on which the subject is reproduced. The shorter focal length (wide angle) lens covers the widest field and reproduces the ship on a small scale. The medium focal length (standard) lens covers a smaller angle, and the ship appears correspondingly larger on the screen. The long focus (telephoto) lens fills the screen with the ship, showing very little of the surrounding area.



Many modern lenses have a visible depth of field indicator. This may use orange-coloured dots which appear or disappear according to the setting (*far left*), or a duplicate set of aperture readings engraved opposite the distance scale (*left*).

Wide Angle and Telephoto Lenses

The human eye can take in a large area, or concentrate at will on a single detail in a scene. The film in the cine camera can only record indiscriminately everything within the field of view of the lens.

Many cameras, however, permit the lens to be changed, and thus the field of view to be altered, by the use of different focal lengths. The lens is in that case unscrewed or unclipped or, in some cameras fitted with lens turrets, moved round, and replaced by an alternative one.

A lens with a shorter focal length than the standard one thus takes in a larger field of view. Such a *wide-angle* lens is useful when a great deal of the subject has to be covered from a comparatively short distance.

The subject will at the same time appear on a smaller scale with details tending to be lost.

Conversely a lens with a longer focal length takes in less, but on a larger scale. Such a lens is known as a *long-focus* or *telephoto* lens. (Strictly speaking, the two differ in lens construction, but the effect is the same.) It is useful for getting near shots of subjects that cannot be approached sufficiently because of obstructions, etc.

The action is therefore similar to that of a telescope or pair of binoculars.

Though the optical principle is different, the same effects are obtained with the afocal wide-angle and telephoto attachments that are available for many cameras not fitted with interchangeable lenses. As with the standard lens, so the focal length of wide-angle and telephoto lenses depends on the film gauge used.

TELE AND WIDE-ANGLE LENSES

Gauge	*Focal Length of Wide-angle Lens*		*Focal Length of Tele Lenses**	
	in.	*mm.*	*in.*	*mm.*
8 mm.	$\frac{1}{4}$–$\frac{3}{8}$	6– 9	1 –1½	25–38
9.5 mm.	$\frac{3}{8}$–$\frac{5}{8}$	9–17	1½–3	38–75
16 mm.	$\frac{1}{2}$–$\frac{5}{8}$	13–17	1½–3	38–75

*Extreme tele lenses may have focal lengths up to twice as long.

Adapters are available to enable some lenses designed for 9.5 mm. and 16 mm. cameras to be used on 8 mm cameras, in which case they give a telephoto effect. But 8 mm. camera lenses cannot be used as "wide-angle" lenses with the larger gauges, as they have insufficient covering power. In other words, they may not evenly illuminate the whole of the 16 mm. frame. For this reason special lens constructions are required as wide-angle systems.

The use of wide-angle and telephoto lenses (or attachments) also provides a means of controlling perspective (page 40).

Focusing

Many cine cameras have a focusing adjustment for setting the lens to the subject distances. Estimate or measure the distance between camera and subject before shooting, and set the focusing ring accordingly. If the exact distance is not marked on the scale, the lens can be set on an estimated intermediate position.

In practice, focusing with cine cameras is not critical at distances much farther than 15–25 feet or so. This is because there is a zone of sharpness at any setting within which everything is sufficiently sharp. This is the *depth of field*, and it is particularly great with the lenses used on cine cameras and at medium apertures. When using a standard or wide-angle lens in good light outdoors, the focusing adjustment can be left at the "infinity" setting, normally marked on the lens mount by the symbol ∞.

But at the wider lens apertures needed in dull weather, when working closer to the subject, and whenever a long focus lens is used, depth of field is reduced, and the subject distance should be accurately measured. This can be done by means of a rangefinder.

The depth of field is thus governed by the focal length of the lens and by the aperture in use. Short focal lengths yield greater depth than lenses of longer focal length. Similarly small apertures give more depth than large ones—hence the need for accurate focusing with long focus and wide aperture lenses.

Many camera lenses carry a depth of field indicator to show the zone of sharpness at any distance and aperture (page 142).

All-Purpose Distance Settings

It is a good plan to find a lens setting which will give the best overall sharpness under average conditions, and leave the lens on that setting so that it is ready for shooting at a moment's notice. As we have seen (page 27), depth of field is affected by the lens aperture and an average setting in this case will depend on the speed of the film used. Suitable apertures would be *f*5.6 for slow black-and-white and colour films, and *f*8 for medium speed black-and-white. Recommended all-purpose distance settings giving a maximum zone of sharpness for these apertures are then as follows:

ZONE FOCUS SETTINGS

	*f*5.6		*f*8	
Lens	*Depth*	*Setting*	*Depth*	*Setting*
8 mm. cameras: 12.5–13 mm. lens	3 ft.–∞	6 ft.	2 ft.–∞	4 ft.
9.5 and 16 mm. cameras: 25 mm. lens	6 ft.–∞	12 ft.	5 ft.–∞	10 ft.

Fixed Focus Lenses

Inexpensive cameras (generally those with lenses of smaller apertures) sometimes have no focusing adjustment. Such fixed focus lenses are usually set by the manufacturer to provide adequate depth of field for a range of near and far distances. As the aperture is stopped down, the depth of field increases in both directions, and some modern lenses are fitted with scale showing the nearest filming distance according to the aperture in use.

For sharp definition at close distances, however, a supplementary lens is required.

To sum up, focusing need not be a worry under average conditions. The only occasions when it is critical are when shooting scenes closer than 10 feet; when using wide apertures, e.g. *f*2 or *f*1.5; or when using a telephoto lens.

Setting the Exposure

With almost all cine cameras the *shutter speed* (that is, the time for which each frame is exposed) is determined by the running speed of the camera; with simpler cameras the running speed and thus the shutter speed are fixed. In most cases, therefore, the lens aperture is the only means of controlling exposure.

The normal filming speed for silent films is 16 frames per second, which corresponds to a shutter speed of about 1/35 second on most cameras. Sound films are normally projected at 24 f.p.s., i.e. 50 per cent faster. When a camera is run at this speed the exposure is reduced to about 1/50 second.

When choosing the lens aperture, the first factor to be taken into account is therefore the shutter speed. Then consider, one by one, the various other factors outside your control which together determine the correct exposure—i.e. lens aperture—for a particular subject.

For average subjects the exposure recommended in tables and cards supplied by film manufacturers with their products can be relied upon to give good pictures. Some cameras, too, are provided with a simplified table giving recommended aperture settings for typical subject conditions.

For the best possible results it is advisable to use an *exposure meter*, which accurately measures the light on the scene.

APERTURES FOR AVERAGE SUBJECTS

Light	*Film Speed* BS° 30°–31° ASA 80–100	27°–28° 32–40	24°–25° 20–25	22° 10
Bright sun	—	*f*16	*f*11	*f*8
Hazy sun	*f*16	*f*11	*f*8	*f*5.6
Light shade	*f*11	*f*8	*f*5.6	*f*4
Cloudy dull	*f*8	*f*5.6	*f*4	*f*2.8

This table applies to the northern hemisphere, from April to October, using cameras running at 16 f.p.s. and giving an effective shutter speed of between 1/30 and 1/40 second.

If the shutter speed of the camera is 1/25 or 1/28 second, use 1/4 to 1/2 stop smaller (*larger f*-number); if it is 1/48 second, use 1/4 to 1/2 stop larger (*smaller f*-number) than would otherwise

be required. Each complete stop is marked on the aperture scale as in the *f*-number series in the table above.

The shutter speed of your camera should be given in the instruction book; if it is not, ask the manufacturer or his agent.

If you intend to run the camera at a speed of other than 16 f.p.s. the aperture must be adjusted accordingly. Such speeds are used either for shooting films to which sound is to be added (page 260), or for trick work (page 187).

Factors Affecting Exposure

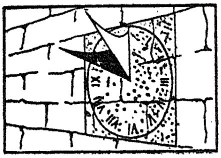
Apart from the shutter speed (see above), there are a number of factors to be considered when determining the correct lens aperture. The nature of the subject is the first point to be considered; then the hour and season; thirdly the lighting angle; and finally the camera position. Before dealing with them in detail, the following tabulation shows adjustments required for conditions departing from normal.

EXPOSURE CORRECTIONS FOR SPECIAL CONDITIONS

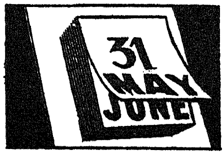
Factor	*Conditions for Standard Exposure*	*Special Conditions*	*Exposure Adjustment*
Subject	Average	Light	½–1 stop smaller
		Dark	½–1 stop larger
Season	May to September	October to April	1 stop larger
Time	2 hours after sunrise to 2 hours before sunset	Within 2 hours after sunrise or 2 hours before sunset	1–2 stops larger
Light	Fairly bright sun	Very bright sun	½ stop smaller
		Hazy sun	½ stop larger
		Cloudy	1–2 stops larger
Direction of Light	Within 45° of front	45–90° (side)	½ stop larger
		90–180° (back)	1–2 stops larger
Camera angle	Level	Low, shooting up	½–1 stop smaller
		High, shooting down	½–1 stop larger
Filter (see page 69)			According to factor

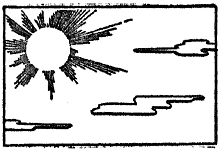
Nature of the subject. Light subjects (e.g. an open landscape) require a smaller, dark subjects a larger, aperture than average subjects. Brightness is, however, not the only factor; relative importance of subject areas must also be considered.

When a person is filmed in close-up so that he occupies the

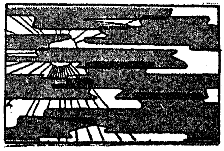


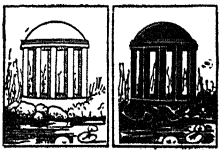
Clock time and season. Mid-day light in summer is more intense than the light at the beginning and end of the day or in the winter.



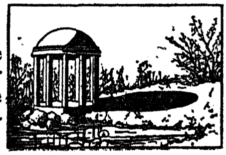


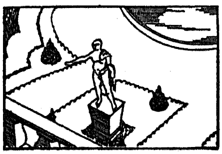
Weather. The light is, obviously, brightest with a clear sky; but slightly overcast conditions may be brighter than you expect.



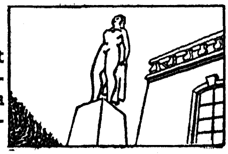


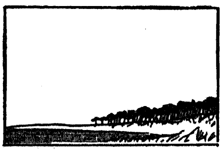
Direction of the light. The same object, filmed in the same weather but with front, rear, or side lighting, may need widely differing exposures.



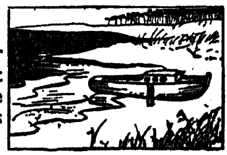


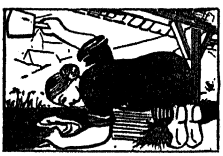
Viewpoint. A high-angle shot will normally require more exposure (larger aperture) than a low-angle view including a considerable area of sky.



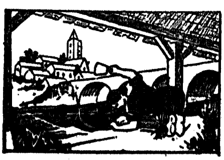


Position of horizon. The lower the horizon in an open distant view, the smaller the aperture required. A higher horizon calls for a larger aperture.





Close-ups. Expose for the ground, in this case the figure and clothes. If they are dark, open up the lens, if light, stop down.



Long shots. The foreground figure no longer predominates, so calculate exposure according to the nature of its surroundings and background.

greater part of the frame area, his colouring or clothing must be taken into account when determining the aperture. If he is wearing light-toned clothes, even if the background is dark in tone, a smaller aperture than normal is required. Conversely, a figure in dark clothing, even if standing against a light background, needs a larger aperture.

This applies to all subjects close to the camera, whether living or inanimate.

On the other hand when the people in the scene take up only a small part of the frame area, the exposure depends on the surroundings or setting only.

Season and hour of day. The light is brighter in the summer than in winter (except in snow scenes); and in the midday hours it is brighter than in the early morning and evening.

Weather. The ideal weather is normal sunlight. The light decreases according to the amount and tone of cloud masses. White clouds cause little reduction in the light, but heavy, dark clouds affect it considerably. A slightly overcast sky is deceptive; the light may be brighter than you think.

Direction of the light and camera angle. The exposure also depends on whether the fully lit side of the subject faces the camera (front lighting) or whether the appreciable shadow areas also appear in the picture—as with side or rear lighting. When rear lighting is used for dramatic effects deliberate under-exposure may, however, be useful.

The camera angle has a similar influence. When the camera points downwards nearly always a larger aperture is required than when you are filming from a low viewpoint with the camera tilted up. That is why exposure is often very critical with vertical panoramic or panning shots (page 44).

Low or high horizon. The position of the horizon in the shot may also affect the choice of aperture. When a large area of sky appears in the frame, a smaller aperture than normal is required, and vice versa.

Sighting the Subject

To guide the camera in sighting the subject a viewfinder is invariably fitted. In its simplest form it consists of a pair of

lenses: the front one with a rectangular frame to outline the subject area, and the rear one acting as an eyepiece. The finder is mounted on, or built into, the body.

When viewing, keep the eye close to the eyepiece and look straight through the finder, not at an angle.

Even on cheap cameras the finder is reasonably reliable for distant subjects. Errors in viewing may, however, creep in when shooting close-ups. This is due to the fact that the finder occupies a position slightly above or to one side of the lens and accordingly "sees" the subject from a slightly different viewpoint. That difference of perhaps an inch or so is immaterial in a distant view, but becomes noticeable when the field covered is only a foot or two wide.

The simplest way of getting over the difficulty is to shift the centre of the view away from the centre of the finder area, towards the lens axis. This means that the eye no longer looks straight through the finder, but the line of sight converges slightly towards the lens.

Naturally this method is a somewhat rough and ready one at the best. More advanced cameras therefore have some provision for tilting the finder by a parallax adjustment calibrated in subject distances. Special devices also exist for really accurate framing and focusing of extreme close-ups, and utilize a finder system for viewing directly through the lens.

Alternative finders are required for lenses other than the standard lens, to cover the different angle of view taken in. Certain viewfinders even incorporate an optical or mechanical framing adjustment, thus covering a range of focal lengths.

Shooting

Finally, the scene is recorded, picture by picture, on the film when you press the shutter release button. And as there is not just one picture, but many hundreds of them, they must all cover exactly the same view if the result is to appear as a steady image on the screen.

The most important rule to observe when filming is therefore to keep the camera *still*, and leave the *movement* to the subject. This means in particular that the camera must be

steady. Films made with an unsteady camera produce a screen image that jumps about disconcertingly and inexorably betrays the amateur.

Use a Tripod

So aim to use a tripod whenever possible; never mind the apparent incongruity of small camera and large stand. The increased firmness and accurate framing obtained are well worth while, and there are several by no means bulky types available on the market.

With a telephoto lens on the camera (page 26) a tripod is absolutely essential: the slightest vibration or wobble in shooting is shown up mercilessly by the magnification of the lens.

Where a tripod cannot be used, a pistol-grip will give valuable support. There are several types on the market with a lever or trigger that can be connected to the release button. Their use enables the camera to be held steadier and started without jerking. As cameras differ widely in design, pistol-grips cannot have a universal fitting; but those which work in conjunction with a cable release can sometimes be fitted to several different makes.

Keep the Motor Wound

Remember always to start filming with the motor fully wound. The spring tension in modern cameras will run the mechanism for between 25 and 40 seconds at the normal running speed, which is more than sufficient for the average individual shot. It is advisable to rewind the motor fully after every shot, to guard against the possibility of the motor stopping in mid-scene.

On most cameras a winding key in the side of the camera serves for winding up. Generally it is not possible to overwind a motor, but all the same avoid using excessive force.

Story Telling Technique

FILM IS A FORM of communication, or pictorial language, which has its own rules of grammar and syntax. These rules have been discovered and defined progressively during the past thirty or forty years.

When you see a feature film at the cinema you follow the story without effort, and without being aware of the intricacies of film making. Yet in the full shooting script of the film the scenes which succeed one another so smoothly on the screen are actually made up of hundreds of individual shots, some lasting for as little as one or two seconds on the screen. A film, in fact, is a patchwork of individual shots, and the art of movie making consists in filming and assembling them so that they create an illusion of smooth continuity in the mind of the audience.

In the very early days of the cinema pioneer film makers usually placed a camera in front of an actual event, or a group of actors, and cranked the handle until the reel was finished. A visit to a revival of early screen classics will show the result of this technique. It is bad cinema—the presentation of the action is completely static.

In order to make films that tell a live story in an imaginative way, we must take a closer look at the raw material of films: the individual shots.

Image Size

Individual shots in a motion picture are classified according to the actual or apparent distance between camera and subject.

A sequence is usually introduced by a *long shot* which gives

a general view of the scene of the action. It may show a landscape, building, a person or persons on an outing; or it may be an interior shot.

Details are not normally clearly visible in a long shot, and it is usual to follow it with a *medium or mid shot*, in which the people, or the action, can be closely identified.

As the action proceeds, the camera may next show a *medium close shot* or *close shot* of some detail of it. It is now so close to the subject that surroundings and background are no longer visible. But they have been established earlier, and the purpose of the closer shots is to show up significant detail. This may consist of a person's expression, the exact shape of an object or the wording of a notice or inscription. In a close-up a person's face, for instance, entirely fills the frame.

When the camera comes even closer to the subject, to show for example only part of a person's face, or detail in a very small object, the shot is a *big close-up.*

The shots just described are often referred to by their initial letters, respectively L.S., M.S., M.C.S., C.S., C.U., B.C.U. There is no absolute rule as to the appropriate designation for a particular shot; it all depends on the kind of subject involved and the scale at which it is reproduced on the screen.

Generally speaking, as indicated above, an action sequence will begin in the long shot, and the camera will then move progressively closer for each successive shot, until the subject changes. This is not, however, a hard and fast rule, and it is nowadays not uncommon in the professional cinema to start with a close shot or close up, the full significance of which is deliberately left obscure until a longer shot reveals the context later.

Creating the Sequence

A simple episode will illustrate the use of long, medium and close shots.

A boy sets out from home on a bicycle trip. The film starts with a long shot showing a house with the front gate in the foreground. At first there is no one to be seen; then the front door opens, a boy appears, takes a bicycle and wheels it down

the garden path. He opens the gate, and is about to mount his bicycle when he leans over and examines the front wheel.

At this moment the camera stops shooting, comes in closer and films a *medium shot* which will show why the boy is bending over his machine. The shot concentrates attention on the cyclist; the house may no longer appear at all in the background. This does not matter, for it was clearly visible in the first shot and has thereby established where the action is taking place.

It is now obvious that the trouble is a flat tyre. But the boy's face has still not appeared, so the camera comes in even closer, and with the camera almost at ground level, takes a *close shot*. This shows all details clearly, not only the boy's face but also what he is doing. He reaches for the pump and starts to inflate the tyre.

These three shots have told the story in pictures. Each shows some detail that is lacking in the other two. It would, of course, have been possible to film the entire scene in a long shot, from a single camera station, but all the significant detail would have been missed, and the result would have been lacking in interest.

Composition

But there is more to cinematography than just filming the subject from various distances. Composition is also important.

Composition is the art of arranging the features of a scene so that it is pleasing to the eye. Some people have a natural flair for good composition; others can learn it by careful study and analysis of professional films, and of the work of great painters.

One of the first lessons of composition can be learned when photographing or filming a landscape. Everyone starts by standing on a hilltop, admiring the view, and photographing it. And everyone has been disappointed at the result. In a print or on the screen, a distant view just looks flat and uninteresting, unless there is some foreground feature to enhance the sense of depth.

The same applies to a medium distant cine shot. Here too

the persons or objects should be so arranged or composed that various planes appear ranged from foreground to background.

If the arrangement is too symmetrical, the shot may look like a posed group photograph. The camera can often be placed to view the scene as if from the eyeline of a person in the left or right foreground, who has been established as present in a previous shot.

Close shots and close-ups of people are a law unto themselves, and no general rule can usefully be laid down as to their composition—except that the camera angle should be slightly oblique and the subject should not look into the lens.

Camera Angles

Whether the camera is held in the hand or secured to a tripod, the direction or angle of aim should be different for every shot. Only rarely will the lens axis be horizontal; much more often the camera will be pointed upwards or downwards, according to the nature of the subject.

When we are shooting a child playing in the sand, the camera will naturally be aimed downwards from above (high-angle shot); but if the child is seen clambering up a ladder, the camera will shoot upwards from a low level (low-angle shot).

By judicious choice of camera angle it is often possible to eliminate unwanted and confusing background detail from a view. This will simplify the composition and make it easier for the audience to follow the relevant action in the foreground.

Choice of camera angle can also serve to provide another kind of emphasis, especially where people are concerned. When filmed from a low angle, an actor appears imposing; the shot suggests power and domination. Conversely, when filmed from above he looks smaller and less important. By taking advantage of this fact the movie-maker can emphasize personality, or even exaggerate it for the purposes of the story.

When interchangeable lenses or attachments (page 26) are available, they can often assist in emphasizing the viewpoint chosen. Wide-angle lenses give exaggerated perspective—closer objects appear relatively larger and more distant objects relatively smaller than in reality. Telephoto lenses have the

opposite effect; objects in different planes appear unnaturally close together. Both types of lenses have many uses for both low and high angle shots. A wide-angle lens used from a low viewpoint, shooting upwards, can be very effective.

But a caution is necessary here. Serious distortion can arise with extremely low or extremely high camera viewpoints especially with a wide-angle lens, leading in extreme cases to caricature.

Arranging the Lighting

We have already seen how exposure is determined by the amount of light falling on the subject; and daylight is constantly varying in intensity. The brighter the light, it might be thought, the more suitable the conditions for filming. But there is more to it than that.

For instance, you may want to film your friends in the garden at noon on a sunny summer's day. So you take up a position with the sun behind you and start shooting. Any people who are facing the camera will have to shield their eyes from the sun, or screw up their faces when looking towards it. There will be heavy shadows under eyebrows and noses, and a noticeable flatness about the picture generally.

But take the picture earlier or later in the day; or wait till the sun is slightly diffused by cloud, and the light will be kinder to the subject. Earlier and later in the day, or towards winter, the sun stands lower in the sky and the longer shadows bring the scene out in greater relief.

When the sun is shining at an angle of slightly more than 90 degrees to the line of sight, i.e. towards the camera, very artistic effects are obtainable. It is, however, important that there should be no large unbroken shadow areas in the picture; shadows, particularly with colour film, are likely to be lacking in detail, and appear as a dark featureless mass.

Against the Light

True against-the-light or *contre-jour* shots can give very fine results, but are risky for the beginner, especially with colour

film. They should preferably be reserved for subjects with plenty of light tones.

For medium and close shots, it is a good idea to follow the example of the professionals and use reflectors. A sheet of white paper in a folding frame, or even a newspaper in an emergency, will greatly assist in lighting the shadows.

When using colour film for the first time, stick to frontal or semi-side lighting. It is certainly possible to work with less direct lighting, but caution is required in these cases owing to the inability of colour film to record more than a narrow range of brightness (see page 86).

Whatever the direction from which the sun is shining, it is a wise precaution always to use a supplementary lens-hood, additional to any already incorporated in the lens. If such an accessory is not available, the camera can often be placed in the shadow of a tree or any other large object. This will prevent the direct rays of the sun from reaching the lens surface where they would otherwise cause internal reflections and thus degrade the quality of the image.

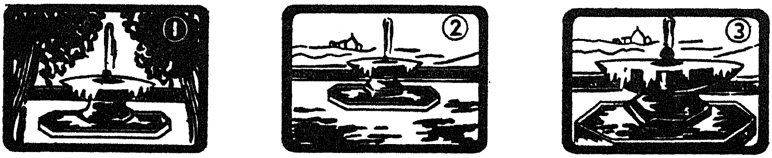
Focal Length and Perspective

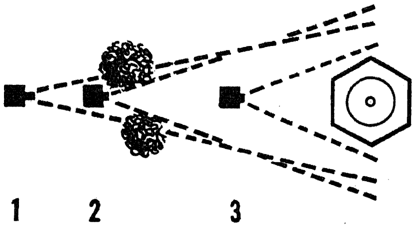
The focal length of a lens determines not only the field of view embraced, but also the perspective rendering. It is thus possible to vary the composition of a shot by judicious choice of focal length.

It is perspective that produces the illusion of depth in two-dimensional pictures. When two persons or objects, known to be of similar size, appear in a picture, we assume them to be close together if they appear the same size, and far apart if one is noticeably smaller than the other.

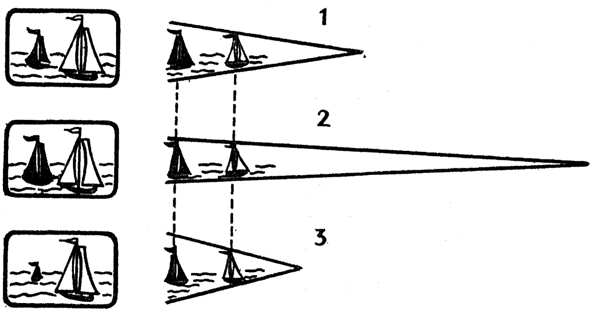
A standard camera lens will reproduce a scene in fairly natural perspective. With a telephoto or long focus lens, the perspective appears "compressed", making objects appear closer to one another than they are in reality. This is due to the fact that the objects also appear larger on the screen—on a scale where we would expect them to differ appreciably in size at different distances.

Conversely, a wide-angle lens increases the sense of depth,





The field of view on the film depends on the focal length of the lens. Interchangeable lenses or lens attachments can often help to improve composition. 1. The fountain is seen to best advantage when framed in the foreground trees, but the viewpoint here calls for a telephoto lens to restrict the angle of view 2. The standard lens gives a view of the fountain from an intermediate position, but the shot lacks interest owing to the absence of a frame. 3. If you stand still closer to the fountain the standard lens cannot take it all in.



The viewpoint governs perspective. 1. From a medium viewpoint the two boats at different distances appear in their correct relative size. 2. From far away the boats appear closer together and of similar size. When the view is enlarged by a telephoto lens, the perspective is flatter. 3. Going close, with a wide-angle lens to take in the whole view, exaggerates perspective. The foreground boat appears larger, that in the background, smaller.

exaggerating the apparent separation between near and distant objects.

Such perspective control with different lenses is particularly effective when the main subject is kept at more or less the same size by going near it with the wide-angle lens, or backing away when the long focus lens is in use.

The wide-angle view will then show a diminutive background, while in the telephoto shot the subject tends to merge into its surroundings.

Perspective and Movement

The same considerations apply where movement is concerned. The shorter the focal length, the faster movement appears to be, and vice versa.

In a telephoto shot of, say, sailing boats, any movement towards or away from the camera will appear to be slowed down, while in the wide-angle shot it will be exaggerated—the boat seems to loom up rapidly in the scene.

The impression of speed is obtained from the alteration in apparent size of the boats. With a telephoto lens, apparent size changes slowly; with a wide angle it changes much more rapidly, hence the corresponding illusions of different speed of movement.

This phenomenon can often be observed in cinema and television newsreels of sporting events. Often subjects appear to move unnaturally slowly; the reason is, of course, that a very long focus telephoto lens was used.

When filming such events bear this point in mind. A telephoto lens can help to get interesting close shots, but where movement takes place towards or away from the camera, or at an oblique angle, the sense of speed is lost.

Many examples of the use of wide angle lenses to obtain an exaggerated effect of space and depth can be seen in illustrated magazines. Large buildings and interior views often appear taller or more spacious in the picture than they are in reality. And in motion picture work we have the further feature of exaggerated speed of movement, whether of subject or of tracking camera.

Suiting the Focal Length to the Picture

Besides the scope offered in the control of perspective and movement, the ability to use lenses of different focal lengths also permits the arrangement of static subject in a variety of different ways. For instance, some foreground feature may be desirable to provide a "frame" for a view of a building or landscape.

In that case simply move back from the original viewpoint and use a telephoto lens to restore the original size of the main subject.

On such occasions a finder (page 147) with optical adjustment for lenses of different focal length is invaluable.

Duration of Shots

As a motion picture portrays life and action, timing is also important and can be used creatively with great effect. Much of this is finalized when editing the film (page 220), but a certain amount of planning helps already during shooting.

Generally speaking it is best to keep individual shots on the long side, rather than to stop filming in the middle of an interesting scene. It is always possible to shorten a scene that appears too long on the screen at the editing stage.

The average duration of an individual shot is between 5 and 10 seconds. A shot should only be held for 20 seconds if it is either of special interest, or includes a lot of detail which the audience needs time to take in. On the other hand, a shot may remain on the screen for as little as 2 seconds, yet be clearly taken in by the audience.

The length of each shot is thus determined by the nature of the subject. If composition is simple and the action easy to understand, there is no need to prolong the shot unduly.

If an episode is filmed from three different camera stations it will, of course, last for more than 10 seconds on the screen. But with the action spread over several shots, the length will not *seem* excessive; on the contrary, the fresh viewpoints offered by the change from one shot to another will provide variety and so maintain interest.

The Panoramic or "Panning" Shot

So far we have considered subjects containing normal movement, which can be filmed without moving the camera during shooting.

Some subjects, however, have movement which would carry them out of the field of view if the camera did not "follow" them. Others, e.g. landscape panoramas, are too wide to be included in a static view.

In such cases, the camera can be swung across the scene in a panoramic or "panning" shot. The movement should be slow and deliberate. For increased steadiness with variable speed cameras it is advisable to set the mechanism to run at 24 frames per second (but remember to open up the lens aperture by half a stop to compensate for the increased shutter speed; see page 131).

When the film is projected, the scene will then appear to move more slowly across the screen, owing to the slight slow-motion effect. A panoramic shot should be planned to end on a pleasant, restful scene, which should be held for a few seconds with the camera stationary.

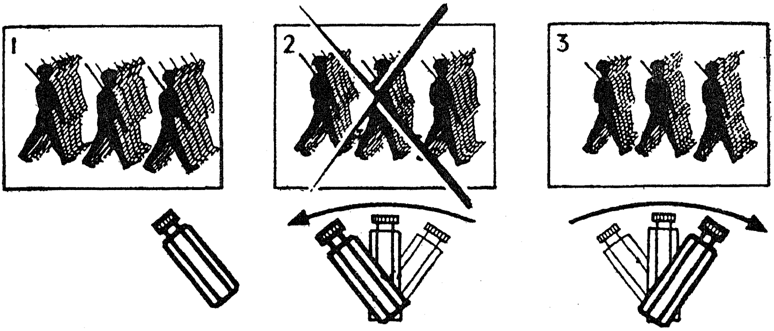
There are one or two important points to watch in making panoramic shots. Avoid in particular swinging the camera vertically upwards from a dense shadow on to sunlit areas, such as are often encountered on buildings and monuments. The resulting final shot will be over-exposed, and details will not stand our clearly against the sky, appearing instead pale grey and "washed out" by the brilliant ambient light. The same difficulty may arise with horizontal movement, too.

As all panoramic shots use a considerable amount of film, it is essential to wind the camera fully before starting to shoot.

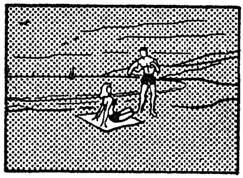
Moving Subjects

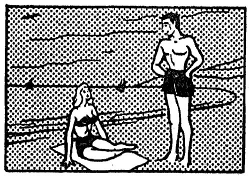
When the subject moves rapidly across the field of view, special care is needed to obtain acceptable results. Street processions are a typical example.

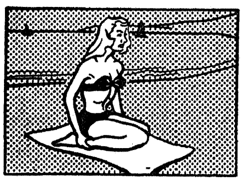
When the movement is at right angles to the line of sight, and no alternative viewpoint is available, swing the camera

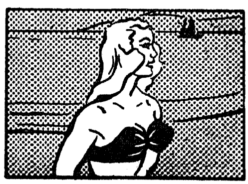


Subjects moving across the field of view call for special care if the result is not to appear jerky on the screen. 1. Aim so that the movement takes place at an oblique angle and towards the camera. 2. On no account swing the camera in the opposite direction to the movement. 3. If an oblique stance is impossible, swing the camera to follow the movement. When editing the finished film separate any repeated panoramic shots by inter-cutting shots taken from different angles, e.g. of other spectators.









Types of shots in films are classified according to their distance and relative content. A long shot (*top right*) establishes the scene in relation to its surroundings. A medium shot (*upper right*) concentrates on the main setting of the scene. A close shot (*lower right*) really moves in on the action, while a large close-up shows up one face or individual point of detail.

round to follow the movement. It is a mistake in this case to hold the camera still; and even worse to swing the camera in the opposite direction to the movement. What often happens is that the cameraman begins correctly by following a group of people with the camera, keeping them centred in the finder as best he can, then suddenly swings the camera away from them and, while it is still running, aims it at other groups following behind. The result is jerky and unpleasant.

The correct method is to take a series of brief shots, following the movement of the subject and stopping the camera as soon as the scene loses interest as it moves out of range. This can be repeated several times. When the film is finally assembled for screening, other shots of different views of the occasion, e.g. crowd reaction, should be inserted between them both to provide variety and to bridge the gap in the time that actually elapsed between the individual shots.

When filming a sporting event or race meeting with rapid movement, it will be difficult to keep the subject in view for more than a second or two from a position near the track, especially where there are crowds of spectators. So look for a raised viewpoint situated some way back and shoot from there, swinging the camera to follow the subject. A panning movement of the camera in the opposite direction to a fast-moving subject must, of course, be avoided at all costs.

Direction of Panning

A panning movement, whether it follows a moving object or ranges over a static subject, should only be made in one direction. There is a great temptation to move the camera about with a static subject. For instance, a massive ancient fortress seems to justify a panoramic movement from left to right, then vertically upward—indeed the audience can consider itself lucky if the movement stops there! The beginner imagines that if the subject is static, the camera must provide the movement. And the result of this so-called "hosepiping" is a succession of unsteady, jerky shots which make it impossible to see the details in the subject, let alone get an over-all appreciation of it.

Such unpleasant effects can be avoided by restricting camera movement to a small area of the subject. If there is strong foreground interest, camera movement can perhaps be dispensed with altogether.

Tracking Shots

In a tracking shot the camera moves bodily while running. It can follow a moving subject, or approach close to a static subject. Though it is not an easy manoeuvre for an amateur, a successful tracking shot can be very realistic.

The first essential for a successful tracking is a firm, wheeled stand or *dolly*, which can be moved without jerking. It should have large-diameter, rubber-tyred wheels. The whole effect is marred if the screen image jumps up and down.

Tracking shots can be made from a car, but the road must be smooth, the tyres should not be pumped up too hard, and the camera should be set to run faster than normal, e.g. at 24 frames per second. When filming from a car in motion, always aim the camera either straight ahead or straight astern; do not attempt to shoot sideways.

Boats, funicular railways and trains provide excellent opportunities for getting tracking shots. Always hold the camera in the hand, *not* placed on a tripod, otherwise the vibration of the vehicle will be communicated to the camera. The body acts as a natural shock-absorber.

Quite a good vertical tracking effect can be obtained by crouching low down with knees bent and camera held in the hand, starting the camera, and rising to full height while the camera runs.

Preserving Continuity

Individual shots of a motion picture seldom, as we have seen, last for more than 10 to 15 seconds on the screen. For the sake of variety, successive shots are filmed from different distances—e.g. the boy setting out on his bicycle (page 36).

In order to preserve continuity it is also necessary to ensure that the shots are *not* filmed from camera positions lying along

a straight line. The angle of approach should be different in each case. Why should this be? The best way to find out is to film the shots in a straight line and see how it comes out. The effect will be that of a camera which jumps forward towards the scene as the action progresses. The change of angle destroys this illusion, and the result—paradoxically—is smooth continuity.

Transitions

Transitions from one shot to another are normally made by a *direct cut.* That is to say, the cameraman stops shooting, moves to another position and starts shooting once more.

Assuming that the shots are projected in the order in which they were actually filmed, the result in such a case is, of course, an immediate transition from one to the other. While there are obvious advantages in taking the individual shots in their final order, they can easily be rearranged in any desired sequence at the editing stage.

Owners of continuously variable focus or "zoom" lenses (page 141) have the further possibility of making a smooth transition from one shot to another by altering the focal length of the camera lens while actually shooting. The impression created is similar to that of the camera moving bodily towards or away from the subject. But this particular method is not suitable for all subjects and situations.

Other transitions are the *fade,* in which the picture appears out of—or disappears into—darkness; and the *dissolve* where the second scene appears superimposed on the first one. As the new scene becomes clearer the old one fades away into nothing.

A fade suggests the passage of a longer period of time, and the dissolve implies a briefer interval. The beginning of any episode should normally be faded in, and its end faded out.

Fades can often be made by closing down (or opening) the lens aperture during shooting. Dissolves call for a camera incorporating a back-winding mechanism. The detailed procedure for both is explained on pages 180–182.

A Simple Subject

We can now try some practical filming. A race meeting will do nicely, though any other sporting event can serve, too.

The first shot (fade in) shows the crowd streaming through the entrance gates: it has thereby established the place.

The camera then comes in closer, starts filming a notice-board announcing the meeting, and pans slowly away towards a group of racegoers armed with binoculars and race-cards. The audience now knows what the *subject* is.

The camera comes in closer still to show details of the impatient crowd pressing through the gates: *the story proper begins.*

And so four or five shots have clearly set the scene for the ensuing races.

The same procedure will apply for the rest of the story. During the first race, concentrate on filming the field as they dash past. When the second one comes, forget the horses for the moment; there is plenty of interest in the grandstand behind. So take some close shots of the punters as they react to the fortunes of the horse they have backed. This will provide some human interest, and perhaps light relief, which can be intercut with distant shots of galloping horses.

The essential point is to show the audience both the event which you yourself came to film, *and* the people who are watching it with you.

When the meeting is over, do not leave without getting some shots to round off the story. Film the horses being led away; the crowd dispersing; the door of the ticket office being closed; and a final shot to drive home the moral: a bookie's card as it is crumpled up by the hand of a disappointed racegoer, before he throws it aside!

To sum up: first establish the subject, then go into the action, which should be treated from a variety of different camera angles, and bring the story to a suitable end. That is the formula for making an interesting and amusing short film of one particular event or theme. It is not a difficult formula, and it can be adapted to almost any subject.

Films

To be sure of good results every time it is necessary to know something of the characteristics of the various kinds of film available for amateur use. Although they have been briefly summed up already, let us now discuss all the aspects of the film material in greater detail.

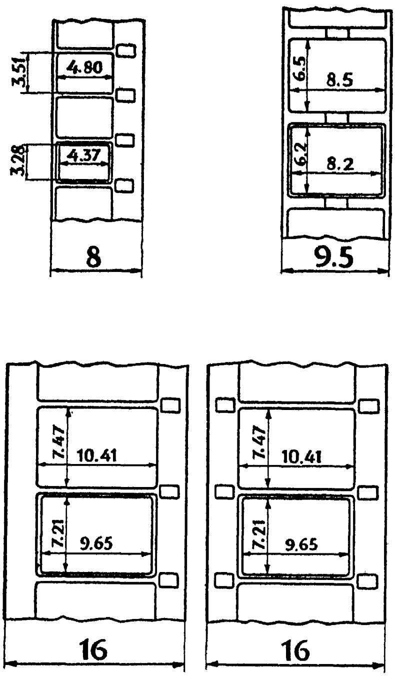
The Film Gauges Compared

The choice of film size is, as indicated on page 15, a compromise between versatility, expense, and convenience. What are the actual factors involved?

The 8 mm. gauge is the most economical one as regards running costs. Extremely compact and light-weight 8 mm. cameras are available, making the gauge ideal for family filming. Models with advanced specifications also exist for the more ambitious worker.

The individual pictures or frames of 8 mm. film measure only 3.51 × 4.8 mm., so they have to be greatly enlarged on projection. Screen images up to about 30 × 40 inches are obtainable, which is quite adequate for home viewing, but larger screen images are seldom satisfactory. Small as the frame is, it is well protected from damage in both camera and projector, because the claw mechanism operates only against the perforations along the edge of the film. The perforations run down one side of the film outside the picture area, spaced out at single frame intervals.

The most common form of 8 mm. film, double-eight, is 16 mm. wide when purchased, with perforations down each side. It is in fact 16 mm. film in which twice the number of

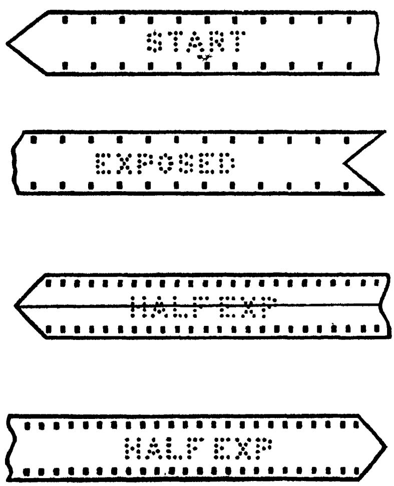


Dimensions in millimetres of the three sub-standard film gauges. The larger dimensions refer in each case to the *camera* gate aperture, the smaller to the *projector* gate. Thus the area exposed in an 8 mm. camera measures 3.51 × 4.8 mm. but the projection area of the finished film measures 3.28 × 4.37 mm. 16 mm. sound films are normally printed on single perforated stock (*left*), the unperforated edge being then available for an optical and/or magnetic sound track. Silent films are normally shot and projected on double-perforated stock (*right*). Magnetic stripe can also be applied to one edge of double-perforated stock, though sound quality is inferior in this case. Frame dimensions are the same for both types of stock.

Leaders and trailers. Spooled 16 mm. film stock has a leader at the beginning and trailer at the end to facilitate loading and unloading the camera. Each is usually from 4 to 6 feet in length over and above the nominal 50 or 100 feet of usable film.

To facilitate identification leader and trailer have the words START and EXPOSED punched in them.

Double-eight spooled film has to be run twice through the camera. During the first run the film is wound on to the take-up spool. To remind the user to re-thread it for the second run, the film has the words "HALF EXP"—i.e. exposed down one side only—punched in it.



perforations have been stamped along both edges; but it is specially spooled for 8 mm. cameras. Ordinary 16 mm. film cannot be used in 8 mm. cameras as the perforations are spaced too far apart.

As double-run 8 mm. film is run through the camera twice, and split down the middle during processing, the final 8 mm. wide strip is double the original length. This is returned to the user on a projector spool.

The majority of 8 mm. cameras accept 25 foot spools of double-eight film, yielding 50 feet of film for projection. There are 80 frames per foot of 8 mm. film, and at the normal running speed of 16 frames per second, a 50-foot reel thus lasts for 4 minutes 10 seconds in the projector (exactly the same as 100 feet of 16 mm. film).

Some manufacturers produce extremely compact cameras designed for single-eight film, which is supplied already cut down to its final size. The principal disadvantage of single-eight film is that the choice of films is more restricted than with double-eight. A limited range of library films, for hire or purchase, is also available in 8 mm., and can be very helpful in programme-building.

The cost of using 8 mm. film in Great Britain ranges from about 5s. per minute with black-and-white film and 7s. 6d. per minute with colour film. These estimates take no account of wastage due to exposure errors and other causes.

The 9.5 mm. gauge is the first of the amateur gauges. Introduced by the French Pathe Company in 1922, it still retains many faithful adherents in Britain, France and elsewhere. Its main advantage is the relatively low cost of the simpler type of camera and projector.

The frame size of 9.5 mm. film (8.8 × 6.5 mm.) is very little smaller than that of 16 mm. film, enabling a reasonably large screen image to be obtained without recourse to a high-powered projector. There are 40 frames per foot and the running time is the same as 16 mm. or one half that of a given length of 8 mm. film.

The perforation holes of 9.5 film are in the centre of the film, one between each successive frame. This has the disadvantage that any damage to the perforations, such as may occur

through incorrect loading of camera or projector, is visible on the screen.

Most 9.5 mm. cameras are designed to accept 30-foot lengths of film in special chargers (page 54). Black-and-white and colour film stock is available ready loaded into the chargers. Generally these remain the property of the film manufacturer and are retained by the laboratory when the film is returned after processing. Black-and-white film can also be bought in tins containing three lengths of 30 feet for loading by the user; special equipment can be even obtained for processing it at home.

Library facilities in Britain are fairly good, especially for those interested in the classics of the silent screen era. Though there are no facilities for producing original sound films in this gauge, sound prints copied from larger gauges can be hired for showing on 9.5 mm. sound projectors.

The cost of using 9.5 mm. film in Great Britain ranges from about 10s. per minute with black-and-white film and £1 per minute with colour film.

The 16 *mm. gauge* is largest of the amateur gauges. It was first introduced in 1923 in the U.S.A. and certainly provides the finest quality—at a price. It is now also widely used for professional purposes and has become the recognized international standard for the production and screening of silent and sound films for industry, medicine, research, education, etc.

The frame size is 10.41 × 7.47 mm., and a powerful projector can provide an adequate screen image for audiences of 200 persons and more. Even a low-powered projector can give an adequate picture for home shows.

Normally 16 mm. film is obtained on 100-foot spools for camera loading, although special chargers for lengths up to 400 feet are used on some cameras. There are 40 frames per foot of 16 mm. film and at normal silent speed one foot therefore runs for 2½ seconds in camera and projector; a standard 100 foot spool thus provides an uninterrupted 4 minute 10 second run.

For the amateur, 16 mm. is expensive. Using reversal film and exposing at the normal silent speed of 16 frames per second, the cost of stock in Great Britain ranges from about 15s. per minute in black-and-white, and £1 per minute in colour.

New apparatus is expensive, too, but secondhand cameras and projectors are obtainable fairly cheaply.

For the serious worker, when many copies are required, and for the production of professional quality sound films, this is undoubtedly the gauge to choose because negative film (necessary for many applications) is not obtainable in 8 mm. or 9.5 mm.

Chargers and Magazines

In addition to the standard spools for 8 mm. and 16 mm. cameras, a range of chargers and magazines is available for certain models in all three film gauges. Naturally the camera concerned has to be designed to take the charger in question.

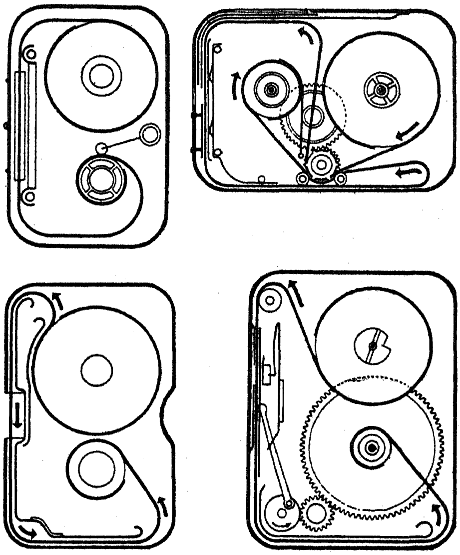
8 mm. Chargers. Two kinds are available. The first takes 33 feet of single-eight film, i.e. cut to the right width before exposure. The advantage of this is that it permits the design of a very flat camera and rapid loading and unloading. This type of charger is similar in principle to (and derived from) the *9.5* mm. charger developed originally by Pathe (see below).

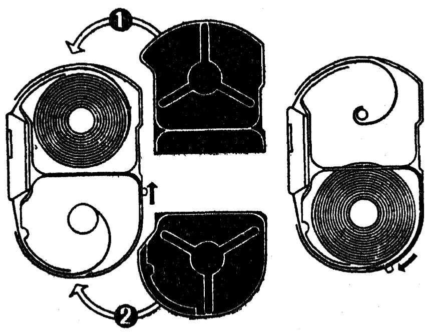
The second type, the double-eight magazine, takes 25 feet of double-eight film. After the first half of the film is exposed, it is only necessary to turn the magazine over, and the camera is immediately ready to go on filming. This of course not only simplifies loading but also permits changing over of emulsions at any time without waste of film, since a sliding shutter on the magazine automatically closes the film aperture whenever the camera is opened.

9.5 mm. Chargers. The first charger for amateur cine film was that brought out by Pathe in the 9.5 mm. gauge. This consists of a flat box of two compartments, both rendered light-tight by a lid. The 30-foot reel of unexposed film is contained in the upper chamber. The film passes through a narrow curved channel (to avoid fogging when the charger is exposed to daylight) before emerging from the chamber, and then passes into the lower chamber through a similar channel. There it is wound up on a core linked to the camera mechanism.

Various models of this charger design exist for specific camera types, and differing in details of shape and dimensions. In some a pressure pad is included (which automatically presses

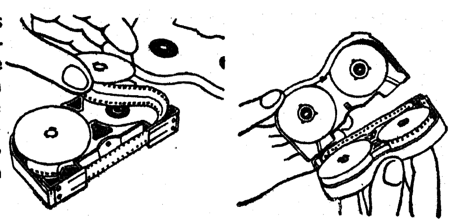
Film magazines for various gauges. *Top left:* 25 feet double 8 mm. *Top right* and *lower left:* 50 feet 16 mm. *Lower right:* 50 feet 9.5 mm. Magazines have the advantage over spools of being instantly interchangeable even if the contents are only partly exposed. This cuts down time lost in reloading and enables the operator to change from one type of film to another at will. Magazines for double-8 mm. cameras are designed to be turned round after the first half of the film has been exposed. The camera take-up spindle then engages with the empty spool, and the film runs through a second time. Magazines have only two drawbacks: it is not possible to wind the film back in the camera for special effects; and film purchased in this form is more costly.





Most 9.5 mm. cameras are designed for charger loading. The film is usually supplied ready loaded by the maker. The special charger shown on the left has two compartments. The upper is loaded with film in the dark and the cover (1) placed in position. The film is then secured to the take-up core in daylight, and the lower cover placed in position (2). A sliding shutter between the compartments (see arrow) is finally withdrawn.

One 8 mm. camera combines the advantages of magazine versatility and spool economy. The user buys his double-8 mm. film in 25 feet spools and loads the magazine in daylight. The magazine is then simply dropped into the camera and shooting can begin without delay.



the film into the gate on loading the camera), or even a complete transport mechanism. Another model takes 30 or 45 feet lengths and has the two separate compartments each with its own lid. This permits the film end to be fixed to the take-up core in daylight, once the film itself has been inserted in the feed chamber in the darkroom.

16 mm. Magazines. The simplest type is the Siemens cassette which takes 50 feet of film and is similar to the double-eight magazine.

The more complex type of magazine, also taking 50 feet of film, incorporates its own film gate, transport sprocket, and film counter. A special shutter covers the film aperture, and is automatically withdrawn on closing the camera, or closed on opening the camera. This permits changing over from one magazine to another in mid-film without loss of a single frame. The counter on each magazine at the same time shows how much of the film in it is still unexposed.

Incidentally, since it is a simple matter to remove the magazine from the camera at a moment's notice, it is easy to insert gate focusing devices in the camera whenever necessary.

Reloadable Magazines

The chargers for single-eight and for 9.5 mm. film are reloadable, taking unspooled 30-foot lengths of film. Loading into the charger has to take place in the darkroom, though the loaded charger is placed in the camera in full daylight.

The standard double-eight and 16 mm. magazines are not reloadable, and the film has to be returned to its manufacturers —complete with magazine—for processing.

To combine the advantage of the charger with that of spools for double-eight and 16 mm. film, some cameras take magazines that can be reloaded with film on spools. The magazine is then handled in the usual way. In certain cases these magazines are complicated pieces of equipment containing the full film transport mechanism, film counter, etc. They may take 50 or 100 feet (in exceptional cases even 200 or 400 feet) of film; the larger capacities are usually found only with magazines for professional 16 mm. cameras.

Many 16 mm. and double-eight magazines close completely when the camera is opened, and thus no waste of film occurs at all when changing over from one magazine to another in mid-film. Where the film passes outside the magazine between the feed and take-up compartments, changing in mid-film will fog about a dozen frames.

With double-eight film magazines of the latter type no changing is possible in mid-film except in the darkroom, since exposure of the outside loop would fog both sides of the film—of the first as well as of the second run-through.

RUNNING TIME AVAILABLE WITH SPOOLS AND MAGAZINES

Gauge	*Capacity of magazine or spool*	*Time at silent speed (16 f.p.s.)*	*Time at sound speed (24 f.p.s.)*
8mm.	25 ft. single-eight	2 min. 5 sec.	1 min. 20 sec.
	25 ft. double-eight*	4 min. 10 sec.	2 min. 40 sec.
	33 ft. single-eight	2 min. 45 sec.	1 min. 50 sec.
	50 ft. double-eight*	8 min. 20 sec.	5 min. 20 sec.
	100 ft. double-eight*	16 min. 40 sec.	10 min. 40 sec.
9.5 mm.	25 ft.	1 min.	40 sec.
	33 ft.	1 min. 20 sec.	50 sec.
	50 ft.	2 min.	1 min. 20 sec.
16 mm.	50 ft.	2 min. 5 sec.	1 min. 20 sec.
	100 ft.	4 min. 10 sec.	2 min. 40 sec.
	200 ft.	8 min. 20 sec.	5 min. 20 sec.
	400 ft.	16 min. 40 sec.	10 min. 40 sec.

*Times apply to finished film, slit ready for projection.

Loading Magazines and Spools

Though magazines and spools are usually purchased ready loaded with film for insertion in the camera in daylight, it is sometimes necessary to carry out loading or spooling at home. This arises in particular when using unspooled 9.5 mm. film.

Loading is best carried out in a darkroom in total darkness.

It is also possible to load films inside the type of light-tight plastic bag designed for changing plates on still cameras.

The exact procedure with magazines and chargers varies according to the make, so that no generally applicable hints can be given. In all cases it is best to practise loading in daylight with a length of blank film before trying the real thing in the dark.

Spools of 16 mm. film can be easily loaded by using a projection spool rewinder. This is not possible with double-eight film as camera and projector spools are not interchangeable.

If any difficulty is encountered in attaching the end of the film on the spool core, the coil of film can first be wrapped in black paper in total darkness, and a few inches allowed to protrude. A ruby safelight can then be switched on and the film end secured to the core. The safelight is then switched off and rewinding completed in the dark.

Some 16 mm. film spools have a round hole in one flange and a square one in the other. Note therefore the position carefully before spooling the film to ensure that it can later be correctly threaded into the camera along the appropriate film path and with emulsion side towards the lens.

Single-perforation 16 mm. film designed for the addition of full-width magnetic sound track (page 272) can be spooled in two different ways. With type "A" spooling the perforated side is placed against the round-holed flange; with type "B" (the commonest), it is placed against the square-holed flange.

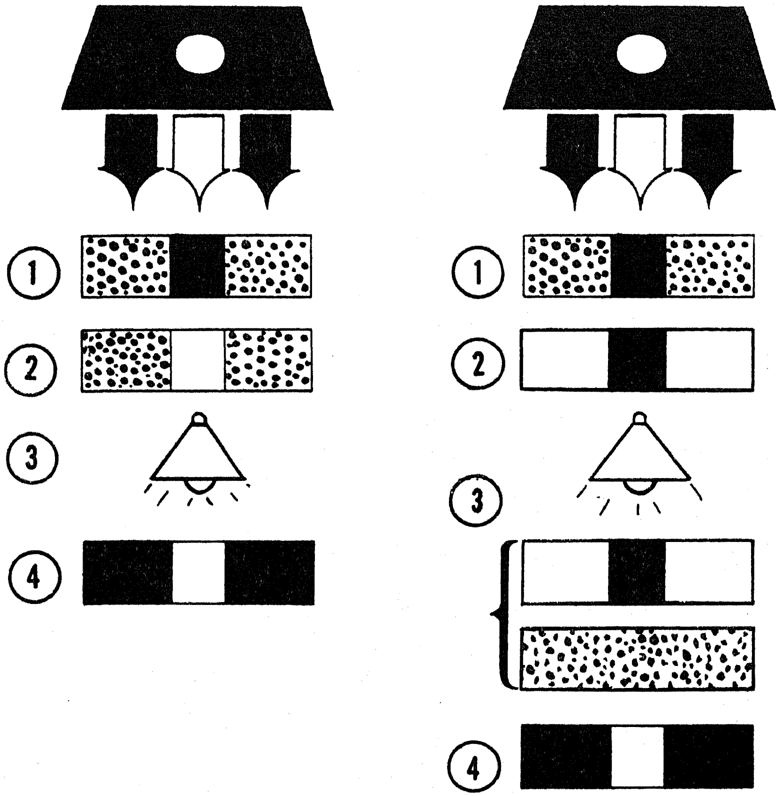
Single-perforation film can only be used in cameras having sprockets fitted with a single row of teeth. Some cameras can be adapted for the purpose.

After loading or spooling, remember to stick a label on the magazine or spool box indicating the type of film used, a most important point for both yourself and the laboratory. Liquid glue or cellulose adhesive tape are preferable to ordinary office paste for this purpose.

Black-and-White Reversal Films

The emulsion side of unexposed film, which must face towards the camera lens, is matt surfaced and cream-coloured. The base side is shiny and usually blue-black or brown in colour.

The base itself is made of cellulose triacetate which is slow burning—unlike earlier cine film which was high inflammable—and presents no fire hazard—hence the term "safety" film. Professional 35 mm. film, too, is now almost entirely made of the same safety material.



1. The silver halide grains of the emulsion are affected by light (white arrows). Development converts them into metallic silver which appears black. When no light strikes the film (black arrows) the emulsion remains unaffected and no blackening takes place on development. The result is a negative image.

2. *Reversal*. The blackened portion is bleached out, leaving only a positive image of unexposed silver halide. The film is then re-exposed to strong artificial light. (3) This renders the remaining silver halide developable. Re-development in a normal negative developer blackens all the silver halide and yields a reversed image (4) in which the tone values match those of the original subject.

2. *Negative*. Fixing renders the image stable and removes the unexposed silver halide. The negative is then printed by contact (3) or projection, producing a positive image (4) in which the tone values match those of the original subject.

The action of light on the sensitive emulsion of the film only becomes visible after processing. The image is said to be latent, and this explains why exposed film when unloaded from a camera looks no different from the unexposed article before it went in.

When an exposed black-and-white film is developed, the image has the tone values of the original reversed, and is called a *negative*. In a still negative of a cloud scene, white clouds will appear dense grey.

The same principles apply to both still and cine cameras; an exposed film produces a negative image. But just as a still negative is useless for final examination of the picture, so a negative motion-picture film is unsuitable for projection. As with snapshots, it would seem the obvious thing to make a positive print from the motion-picture negative for projection purposes.

But here the requirements differ. While it is very useful to be able to have a number of prints made from a still negative, in amateur cinematography there is seldom need for more than a single copy of the film.

This explains why film manufacturers have produced a special reversal film.

Reversal film is processed by a special method which reverses the initial negative to a positive. The film that comes back from the laboratory is thus the same actual strip that ran through the camera—and this applies to both black-and-white and colour emulsions.

There is no difficulty about having further positive copies printed from a 16 mm. reversal positive. Many laboratories are equipped for making duplicate ("dupe") prints from 16 mm. reversal black-and-white and colour originals; the results are of excellent quality and hardly distinguishable from the original.

It is also possible to print from one gauge to another, for example from 16 mm. to 9.5. mm. or 8 mm. For obvious reasons better results are obtained when printing from a larger gauge to a smaller, rather than the other way round. The converse is however possible, though a considerable loss of quality must be expected.

Black-and-White Negative Film

While reversal film is the article normally used by amateurs in all three gauges, negative stock is available in the 16 mm. gauge. The serious worker producing a film for technical, educational or advertising purposes may well find negative stock more suitable.

Production on a semi-professional basis on 16 mm. film involves the same procedure as is current with standard 35 mm. film. To start with, the editing stage involves a great deal of physical handling of the film and it is repeatedly run through a viewer and projector. A work print or *cutting copy* is therefore made from the original negative so that these operations can be carried out without fear of spoiling the master copy.

When the editing stage is completed and the film has reached its final form, the negative is then cut to match, and as many copies as required for distribution purposes printed from it. The prints in question will then be free of splices.

At the same time, any desired special effects such as fades, dissolves and superimpositions can be provided by the laboratory, if they were not made in the camera at the shooting stage. The final stage may be the provision of an optical or magnetic sound track along one side of the film.

Colour Response

All black-and-white stock intended for camera use—whether of the reversal or negative type—is known as *panchromatic*. This means that it gives a reasonably accurate rendering of all the colours of the subject in terms of shades of neutral grey.

The silver bromide grains which make up the active constituent of the emulsion are inherently sensitive to blue and insensitive to red. Special dyes, however, increase the response to the red end of the spectrum for a balanced reproduction.

On the other hand it may be desirable to increase the natural contrast between colours; this is done by means of coloured filters (see page 69).

Positive black-and-white film, intended for making projection prints from negatives, is coated with a plain non-colour-

sensitive emulsion which is sensitive to blue only. This permits handling and processing by orange or bright red darkroom illumination.

Positive film is not normally used in the camera, except possibly for shooting titles.

Film Speed

To indicate the relative sensitivity or *speed* of their emulsions, film manufacturers use various systems, usually numerical. The figures are printed either on the carton or on an instruction sheet enclosed with the film.

FILM SPEED SYSTEMS COMPARED

BS (Log.)	*ASA (Arith.)*	*Weston* (Arith.)*	*DIN (Log.)*	*Scheiner (Log.)*	*Relative Speed*
19°	6	5	10/10°	20°	1
20°	8	6	11/10°	21°	1¼
21°	10	8	12/10°	22°	1⅗
22°	12	10	13/10°	23°	2
23°	16	12	14/10°	24°	2½
24°	20	16	15/10°	25°	3¼
25°	25	20	16/10°	26°	4
26°	32	25	17/10°	27°	5
27°	40	32	18/10°	28°	6½
28°	50	40	19/10°	29°	8
29°	64	50	20/10°	30°	10
30°	80	64	21/10°	31°	12½
31°	100	80	22/10°	32°	16
32°	125	100	23/10°	33°	20
33°	160	125	24/10°	34°	25
34°	200	160	25/10°	35°	32
35°	250	200	26/10°	36°	40
36°	320	250	27/10°	37°	50
37°	400	320	28/10°	38°	64

*Speed system used on Weston Master I and II exposure meters. The Weston Master III meter actually uses speed ratings which for all intents and purposes are identical to the ASA arithmetic numbers, though on this meter they are still called Weston ratings.

Britain and the U.S.A. have adopted a common standard of film speed measurement which is expressed in either logarithmic or arithmetic terms. The logarithmic scale is widely used in Britain and the speeds are quoted in degrees (°BS); the American arithmetic scale (ASA numbers) is common in North America and the European Continent.

In the logarithmic scale every increase of 3 degrees doubles the effective speed. In arithmetic scale, the speed is directly proportional to the index number. The two scales are directly convertible.

Other systems frequently met with are the Weston (arithmetic), and the Scheiner and DIN (German Standard) logarithmic scales. These are only approximately convertible, as the actual methods of speed measurement are different.

With black-and-white film the speed rating applies to exposure by daylight only. In artificial light the rating is usually somewhat lower.

Exposure meters have provision for setting according to the speed of the film in use (see pages 65–66).

Other Properties of Films

Films differ also somewhat in the way in which they reproduce the tone gradations and the detail in the subject. These properties are to a large extent tied up with the film speed, inasmuch as fast films happen to behave differently from slow ones in respects other than speed alone.

Generally, slow films yield finer grain than the fast types. That means that the silver bromide crystals—which eventually are turned into silver—are smaller on the average in a slow film.

In a coarse-grained film the fine image detail tends to disappear because it is broken up by the grain structure of the emulsion. Even though the graininess as such is not visible on the screen in quite the same way as in a normal photographic enlargement, the impression of coarseness remains.

Graininess with an ultra-fast film is particularly noticeable on negative stock; reversal processing to some extent tends to reduce the effect. This is one reason why negative film is only available in the 16 mm. gauge, and why no really fast films are made in 8 mm.

Slow films also tend to yield more contrasty images—another feature that is of more importance with negative film.

All modern reversal films carry an anti-halo layer which enables them to record subjects having extreme brightness

differences without halation. This phenomenon—due to light being reflected back again from the film support after passing through the emulsion—causes loss of detail, especially of fine dark detail against a brilliant background. Bright image points may also become diffused owing to the scatter of light in the emulsion.

The anti-halation layer—usually grey silver between emulsion and support—largely eliminates this trouble by absorbing light rays once they have passed through the emulsion. The anti-halo layer disappears during reversal processing.

Negative films have a tinted base (normally grey or purplish) which acts similarly, but is not removed in processing. (Negative films are never projected, but only printed; the tinted base does not interfere with that operation.)

Choosing Films

From the point of view of all-round usefulness a medium speed film of 27–28°BS is, as already mentioned, the best to choose. When the light is good, use a slower emulsion of 22–25° BS; for very brilliant scenes this may even be the only film suitable, as the aperture of some cameras cannot be stopped down far enough to avoid overexposure with a faster emulsion.

The fastest films of 30–34°BS should, in view of their increased graininess, be reserved exclusively for scenes in unfavourable light which cannot be recorded satisfactorily on slower stock.

Colour Films

All colour films for amateur cine work are of the reversal type, giving a natural colour image by the subtractive principle.

The film base is coated with three superimposed emulsion layers, respectively sensitive to blue, green and red. Between the blue and green layers there is a yellow filter layer which holds back blue light, thus preventing it from affecting the green and red sensitive layers. During processing the silver image formed in each layer is replaced by a hue of a colour complementary to the colour of the part of the subject there

BLACK-AND-WHITE CINE FILMS

Make	*Film*	*Speed* °BS	*Speed* ASA	*Uses*
8 mm. Reversal Materials				
Adox	U 17	27°	40	All-round
Agfa	Isopan F	25°	25	Scenes in good light
Ferrania	Reversal 28	27°	40	All-round
	Reversal 32	31°	100	All-round or poor light
Gevaert	Gevapan 23	22°	12	Bright scenes
	Gevapan 26	25°	25	Scenes in good light
	Gevapan 32	31°	100	All-round or poor light
Kodak	Super X	27°	40	All-round
9.5 mm. Reversal Materials				
Bauchet	Super Pan 26	25°	25	Scenes in good light
Ferrania	Reversal 28	27°	40	All-round
	Reversal 32	31°	100	All-round or poor light
Gevaert	Gevapan 23	22°	12	Very bright scenes
	Gevapan 26	25°	25	Scenes in good light
	Gevapan 32	31°	100	All-round or poor light
Pathescope	SX	25°	25	Scenes in good light
	VF	31°	100	All-round or poor light
16 mm. Reversal Materials				
Adox	U17	27°	40	All-round
Agfa	Isopan F	25°	25	Scenes in good light
Ferrania	Reversal 28	27°	40	All-round
	Reversal 32	31°	100	All-round or poor light
Gevaert	Gevapan 23	22°	12	Very bright scenes
	Gevapan 26	25°	25	Scenes in good light
	Gevapan 32	31°	100	All-round or poor light
Kodak	Plus X	28°	50	All-round
	Tri X	34°	200	Very unfavourable light conditions, not recommended in normal daylight
16 mm. Negative Materials				
Adox	N17	27°	40	All-round
Ansco	Supreme	28°	50	All-round
Gevaert	Gevapan 27	26°	32	All-round, especially outdoors
	Gevapan 30	30°	80	All-round or poor light
	Gevapan 33	32°	125	Unfavourable light conditions
Ilford	Pan F	25°	25	All-round outdoors
	F.P.3	29°	64	All-round
	H.P.3	34°	200	Very unfavourable light conditions, not recommended in normal daylight
	H.P.S	37°	400	Fastest film for extreme conditions, dusk, artificial light, night, etc.
Kodak	Plus X	30°	80	All-round or poor light
	Tri X	36°	320	Fastest film for extreme conditions, dusk, night, artificial light, etc.

recorded. When the finished film is projected, the dyes in the various layers combine on the screen to reproduce the original colours of the subject.

Daylight and Artificial Light Types

Two different reversal emulsions are available for filming in colour: a daylight type for use outdoors; and an artificial light type (often known as type A) for exposure by the light of overrun Photoflood bulbs. The reason is that there is a great difference in the spectral composition of these two light sources: daylight is richer in blue rays; Photoflood light is much more yellowish. No reversal colour emulsion would give a satisfactory colour rendering under both types of light.

The "blueness" or "redness" of a continuous-spectrum light source (e.g. sun, or a light bulb or Photoflood) can be measured in terms of its colour temperature (see page 102).

COLOUR CINE FILMS

Make	*Film*	*Speed* °*BS*	*Speed* *ASA*	*Type*
8mm. Reversal Materials				
Agfa	Agfacolor T	25°	25	Daylight
Ansco	Anscochrome 231	26°	32	Daylight
	Anscochrome 232	25°	25	Tungsten (for use with Photofloods)
Gevaert	Gevacolor R5	21°	10	Daylight
Kodak	Kodachrome	21°	10	Daylight
	Kodachrome A	23°	16	Photoflood
9.5 mm. Reversal Materials				
Kodak	Kodachrome	21°	10	Daylight
	Kodachrome A	23°	16	Photoflood
Pathescope	PCF	22°	12	Daylight
16 mm. Reversal Materials				
Agfa	Agfacolor T	25°	25	Daylight
Ansco	Anscochrome 231	26°	32	Daylight
	Anscochrome 232	25°	25	Tungsten (for use with Photofloods)
	Anscochrome 242	21°	10	Tungsten (for use with studio lamps)
	Super Anscochrome	31°	100	Daylight (a tungsten type also available)
Gevaert	Gevacolor R5	21°	10	Daylight
Kodak	Kodachrome	21°	10	Daylight
	Kodachrome A	23°	16	Photofloods

The human eye is far more adaptable than photographic film, and can accustom itself to widely differing kinds of light. According to whether blue or red predominates, the eye automatically increases its sensitivity in the required direction, until balance of colour vision is restored. Thus after a country walk, the colours of a bunch of flowers seen under electric light indoors will not seem unnatural. But if the same daylight colour film were used for a landscape and to photograph these flowers, the latter would have an objectionable over-all yellow "cast" or tinge. Conversely, if artificial light film is used in daylight, the scene has an over-all blue cast.

Care is therefore needed in choosing the right type of film for the subject envisaged. It is also possible to expose a given type of film in the "wrong" lighting, provided a conversion filter is used (see page 103).

Storage of Unexposed Film

In temperate regions the only precaution necessary with unexposed film is to keep it away from excessive heat and humidity.

It is not advisable to leave a partly-exposed film in a camera for any length of time, e.g. several months, as this may have an adverse effect on the latent image.

Colour films should be sent for processing as soon as possible after exposure, though a few weeks one way or another will make no difference. When several spools have been exposed on one subject or story, it is best to send them to the laboratory together to ensure uniform colour balance.

All films are marked with an expiry date. With black-and-white films it is permissible to use films for a few months after this date, provided that they have been stored in suitable conditions. Colour films deteriorate more rapidly, and should be used and sent for processing as promptly as possible.

An out-dated film gradually loses speed; colour film may also lose colour balance owing to differential ageing of the emulsion layers. If a film is exposed within six to nine months after the expiry date, the lens aperture should be opened up from a half to one whole stop, to compensate for this loss of speed.

Tropical Storage

Special precautions are necessary for the storage of unexposed films in the tropics. The best method is to place the film in a special container which can be hermetically closed. A less satisfactory alternative is to keep it in metal cans sealed with adhesive tape.

When film is stored in hermetically sealed tins, a cartridge of silica gel should be placed inside with it, to absorb moisture. Silica gel intended for this purpose usually contains a substance which is blue in colour in an anhydrous state and turns pink when moist. It can easily be dehydrated by placing it in an oven at a temperature of 150–200°C. until it turns blue again. It can also be heated by an electric fire, but must not be exposed to a naked flame.

A refrigerator can also be used for storage of film in sealed containers, but the films must be removed from it 24 hours before they are needed, so as to avoid condensation when the cold film surface encounters the warmer air.

The camera should be unloaded as soon as the film is completely exposed. The film is then replaced in its tropical packing (but not sealed with tape, otherwise harmful moisture cannot escape), then dispatched to the nearest laboratory as soon as possible.

If for any reason a film has to be kept for a period after exposure, it should be dehydrated before being returned to its wrapping. This is done by placing it in a hermetically sealed can together with a cartridge of silica gel, or in its absence, dried tea leaves or grains of rice. After this treatment the film is replaced in its original metal can, sealed and kept under refrigeration.

The foregoing procedure is applicable to all emulsions, and should be followed with particular care in the case of colour film.

Filters

As mentioned before, the colour sensitivity of panchromatic film is reasonably similar to that of the eye and thus permits fairly accurate reproduction of the brightnesses of colours in tones of grey.

But for all that the film emulsions are still unable to adapt themselves to all the possible requirements of tone reproduction. Thus it is often useful to increase the contrast between two colours of similar depth, for instance in long shots where the eye may be able to differentiate them, but the film, reproducing everything in grey, cannot.

On other occasions it may be desirable to reproduce a particular tone lighter or darker than the unaided film is able to do.

The judicious use of filters can not only aid in achieving a more forceful photographic quality but also to control to a certain extent the mood of a scene. In special cases filtering may change the atmosphere completely, for instance by making a summer day look like an imminent thunderstorm or creating night effects with daylight scenes.

Indoors there is rarely any need to use filters, mostly they only complicate matters unnecessarily.

The coloured filters (yellow, green, orange, red) described in the following pages can only be used with black-and-white film. The polarizing and neutral density filters (pages 74–75) can be used with either black-and-white or colour film. For use with colour film, the ultra-violet filter (page 73) must itself be colourless.

Filters intended for use with colour film *only* are dealt with on pages 93 and 103.

Filter Mounts

A filter consists of a piece of dyed optical glass or a sheet of gelatine. In the latter case it is, or should be, cemented between thin glasses.

This sandwich—or the dyed glass—is then held in a mount for fitting to the lens.

Mounts can be of the slip-on or screw-in type. The screw-in type is to be preferred, as there is no risk of the filter falling off and getting lost just when it is needed.

Some filter glasses are interchangeable, a set consisting of a single unscrewing mount and several detachable glasses. Though this would appear to have the merit of simplicity, separate mounts for each filter are preferable. They can then be rapidly fitted on the lens, and as less handling is involved the danger of finger-marks, which impair definition, is reduced.

Unmounted gelatine is even more vulnerable to accidental damage, and if a filter of this type has to be used (special filters for use with colour film are often supplied in this form) and your lens-hood is of the screw-in type, the following procedure is recommended. Measure the diameter of the lens-hood thread, sandwich the filter gelatine between two sheets of paper and cut out a circle of the requisite diameter. Avoid touching the gelatine directly at any stage. Insert the gelatine behind the lens-hood and screw the latter home.

Alternatively, it is sometimes possible to remove the front element of the lens itself and insert a gelatine filter cut to the appropriate size. In either case, the arrangement should only be regarded as a temporary expedient, and the filter should be fitted in a permanent mount as soon as possible.

When mounting a filter, it is not sufficient to place the gelatine sheet between two glasses; the sandwich must be cemented together, or definition will suffer. Cementing is a specialized and delicate operation and should be entrusted to the filter manufacturer.

When a filter is required for use on a wide-angle lens or attachment, it is important that it should be of sufficiently large diameter, otherwise the corners of the field of view may be cut off. Unless the camera has provision for using a single

set of filters for all lenses, it is therefore important to ensure that the filters are properly matched to the lenses.

A filter should never be used without a lens-hood. The filter mount usually has a screw thread at the front identical with that of the lens into which it fits, enabling the lens-hood to be screwed at will either directly on to the lens or into the filter.

Telephoto lenses are usually supplied with a built-in lens-hood, and the filter is attached by removing the hood, screwing the filter, and replacing the hood in front of the filter.

Two Essential Filters

The wide range of filters available for black-and-white film will leave the beginner bewildered as to the right choice to make. A good advice is to start with two only: medium yellow and green. When you have learned how to use them, you can complete your equipment with full knowledge of the results obtainable.

The Yellow Filter

The principal uses of a yellow filter are in landscape shots, mountain and seaside views; and to enhance cloud effects.

It is often found that a landscape which looked impressive at the time, appears very flat on the screen; detail is lost, and distant hills that stood our clearly against the horizon merge imperceptibly into the haze.

Cloud effects are also tempting subjects, yet often equally disappointing. The eye can clearly distinguish the white of the clouds from the blue of the sky, but here too the film may not give a true rendering to the relative tone values, reproducing them instead as similar shades of grey.

In both of these cases an improvement can be obtained by using a medium yellow filter. The effect can easily be judged by holding it up to the eye; it is similar to that obtained when wearing yellow-tinted sun-glasses.

The reason for using a yellow filter is that its colour is complementary to blue, and consequently holds back part of the light of this colour. The sky area is thus comparatively under-

exposed and appears darker on the screen, so contrasting clearly against the white of the clouds.

With colours other than blue, a yellow filter has little effect; it passes green and red, so that when these colours predominate the rendering is more or less normal.

The Green Filter

A yellow filter will meet most requirements but there are occasions when it is necessary to correct the inadequate response to green which is characteristic of panchromatic emulsions. This often occurs in landscapes, which tend to come out rather too dark. As filters pass their own colour and hold back the complementary colour, it is clear that a green filter is called for in this case.

Multiplication factors of the filters described above will be in the region of $\times 2$ and $\times 3$ (see page 75), requiring the lens aperture to be opened by 1 or $1\frac{1}{2}$ stops.

If it is desired to keep equipment to an absolute minimum, a single yellow-green filter can be used; but the range of effects obtainable will then be more restricted.

Contrast Filters: Orange and Red

Whereas yellow and green filters are used to correct errors in colour rendering, orange and red filters are used to increase the contrast between certain colours for special effects.

Filters for contrast purposes are also selected on the same basis as yellow and green; when a colour is to be rendered *lighter*, the filter must be of the same colour; when it is to appear *darker*, the filter must be of a complementary colour.

When an orange filter is used, red, orange and yellow in the subject are rendered lighter, blue and green darker. The shot gains in impact; the shadows are darkened and form a powerful contrast to the highlights and reflections.

A medium orange filter (factor $\times 4$—open up two stops) is the most generally useful one. The resulting over-correction is not excessive and is suitable for many subjects.

A deep orange filter gives more dramatic effects. Shots of

skiers taken against the light with such a filter can be very striking. The skiers in action will appear in silhouette against a dark sky, and the powdered snow thrown up as they turn will glisten strongly in the sunlight. Similar results can be obtained by filming sailing craft entering harbour with the light behind them. The white sails will stand out against the sky and reflections in the water will be prominent. The cloud effect will also be impressive.

The contrast is still further increased with a red filter; the darker the filter the more pronounced the result. The filter requires a great deal of extra exposure, so that plenty of light is called for. Middle tones will tend to disappear as the filter density increases. Landscape and marine views in which the horizon is very low and dominated by cloud formations are particularly suitable for shooting through a red filter. Any people figuring in the scene will appear in silhouette.

An extreme case is that of "moonlight" effects shot in bright sunlight with the aid of a red filter. The aperture is set to give considerable underexposure, i.e. it is closed down one or two stops more than the scene would normally require.

The subject should be brilliantly lit with well defined areas of highlight and shadow, such as for example an architectural setting or a pier or jetty with a lighthouse at the end. Normal landscapes are not suitable for the purpose. All detail will be suppressed, and the scene will be reduced to its principal masses, under a dark sky, with here and there a person, wall surface or gateway standing out stark white.

The Ultra-Violet Filter

Ultra-violet radiation is invisible to the eye but strongly affects photographic film. The light over large areas of water—lakes or at the seaside—and at altitudes over about 5,000 feet is very rich in ultra-violet rays. These are liable to cause loss of image definition, since the correction of most lenses does not take into account the ultra-violet region of the spectrum. Ultra-violet radiation is only present in fine weather and should not be confused with the effect of mist or fog which scatter visible light.

An orange filter can be used to eliminate the excess ultra-violet radiation which appears as atmospheric haze in the picture, but it has the disadvantage of darkening the sky to an unnatural degree. It is therefore better to use a special U.V. filter for the purpose, as it does not affect the colour of the sky which is reproduced at normal density. No alteration of lens aperture is required when using this filter.

Note that if the atmospheric haze is eliminated too completely, some loss of pictorial value results. Part of the charm of distant views lies in the soft definition and the gradual falling off of contrast with increasing distance (the so-called atmospheric perspective). To preserve a sense of depth it is advisable to introduce some prominent dark tone into the field of view; this can often be done by including some foreground feature.

The Polarizing Filter

The polarizing filter, which is generally neutral grey in appearance, has the unusual property of darkening blue sky to a greater or lesser extent. This effect depends on the angle at which the sky is viewed and the orientation of the filter itself. The other colours of the subject are not affected at all in the process.

The filter also enables reflections from non-metallic surfaces to be reduced, but this is utilized more in still photography than in the cinema.

The effect of the filter can be observed by simply looking through it; it is then rotated in its mount until the desired position is found, and placed over the lens in the same orientation. If it is rotated while the camera is running, reflections vary in intensity, and the density of the sky changes, producing effects which an ingenious film-maker can turn to good pictorial use.

Apart from its polarizing properties, this filter can also be used in the same manner as a neutral density filter (see below). When two polarizing filters are placed together and moved in relation to one another, a variable density filter combination results.

Neutral Density Filters

A neutral density filter is unlike all those so far described in that it has no selective effect on the colours of the subject. Its main use is to reduce the amount of light reaching the film. Depending on its density, it requires the aperture to be opened up one, two, or three stops.

Neutral density filters are useful when the lens cannot be stopped down far enough for the subject. When the smallest available lens aperture is *f*11 or *f*16 and you film a light-toned subject in bright sunlight with medium-speed or fast film, use of a neutral density filter is a convenient way of avoiding over-exposure.

Another use of the neutral density filter is an indirect one for keeping the background of a close shot unsharp. To do this the depth of field (page 27) must be reduced by employing a wide lens aperture. If a neutral density filter with a factor of 4× is used, the aperture can be opened two whole stops.

Filter Factors and Lens Apertures

We have already referred to the multiplication factor applying to all filters except the ultra-violet one. All such filters reduce the amount of light reaching the film; steps therefore have to be taken to compensate for this loss by increasing the exposure.

This exposure increase is indicated by the factor; for instance a 2× filter needs double the normal exposure. On a cine camera this is normally done by opening the lens aperture. As the iris diaphragm is calibrated so that each division or stop halves or doubles the amount of light admitted by its neighbour (page 24), this is a simple matter, as shown below.

FILTER FACTORS AND APERTURE CHANGES

Filter factor	*Number of "stops" by which the aperture must be opened*
2x	1
3x	1½
4x	2
6x	2½
8x	3

FILTER EFFECTS WITH BLACK-AND-WHITE FILM

Subject	*Effect desired*	*Filter Recommended*
Landscapes		
Open views	Normal	Yellow or light green
	Lighter than normal	Deep yellow or green
Panorama	Increased effect of mist or haze	No filter
	Normal	Yellow
	Reduction of mist	Yellow, mid-green or orange
	Specially clear distance rendering	Medium red
Very open riverside scenes	Lighter foliage	Light green
Seaside views	Increased contrast	Deep yellow or orange
Trees and flowers	Normal, with darkened sky	Yellow, light green or polarizing filter
Autumn tints	Lighter	Deep yellow or orange
Seaside Views		
Beach scenes	Normal	Yellow or U.V.
Harbour	Normal	Yellow
Cliffs, rocks	Dark sea, lighter waves	Deep yellow
Sailing boats at sea	Increased clarity and contrast	Deep yellow, orange
Mountain Scenery		
Summer, with vegetation, moderate altitudes	Normal	Yellow or light green
	Increased contrast	Yellow or medium green
	Very dark sky	Deep yellow or orange
Above 5,000 ft.	Reduction of haze, normal sky	U.V.
Snow, winter sports	Normal	Medium yellow
	Contrasty silhouette effect	Deep yellow or orange
Miscellaneous		
Cloudy sky or sunset	Dramatic effects	Deep yellow or orange
Shots from aircraft	More detail in distance	U.V. or orange
Telephoto shots	Improved contrast	Medium yellow or orange
Blue sky used as background	Normal	Yellow
	Dark	Deep yellow
	Very dark	Orange
	Almost black	Red
Light-toned buildings	Normal	Yellow
	Increased contrast	Deep yellow or orange
	Darkened sky	Polarizing filter
Colourful costumes	Normal	Medium yellow
Orange and red coloured clothing and flowers	Lighter, with improved detail	Deep yellow or orange
Landscapes or buildings with strong highlight areas	Night effects	Red plus polarizing filter

Except for the polarizing filter, none of the above filters can be used with colour film

Thus if the working aperture is $f8$ and you decide to use a 2× yellow filter, you must open up the lens to $f5.6$, otherwise the film will be under-exposed.

When filters are supplied by film manufacturers for use with their materials, the appropriate factors are quoted in data sheets and can be relied upon.

Filter factors are not always marked on the filters themselves, for the very reason that the factor varies according to the film. The best way to ascertain the factor for individual cases is to make practical tests.

Do not use filters of different colours in conjunction. As different coloured filters hold back light of different colour, the composition of any light remaining after passing through two different filters would bear little relation to that reflected by the original scene.

Care of Filters

Keep all filters absolutely clean and treat with the same care as lenses, using a fluffless cloth or camel-hair brush for cleaning. Minor surface blemishes on glass filters need cause no concern, as they will have no appreciable effect on definition.

Gelatine filters should be carefully preserved from damp, which may effect the cement and render them unusable.

Do not expose any filter to direct sunlight longer than absolutely necessary. The best means of storage is to keep the filters in a leather case with separate compartments, unless there is room for them in the camera case.

Exposure Meters

AN EXPOSURE METER is a valuable accessory, and virtually indispensable when shooting colour film. It can greatly simplify the task of determining the correct exposure. But useful as it is, it must be used intelligently, for it cannot *think*.

Exposure meters are precision instruments incorporating a photo-electric cell coupled to a micro-ammeter. This combination measures the intensity of the light reflected by (or incident on) the subject and indicates a reading by a pointer which usually moves over a scale calibrated in relative light intensities. A calculator dial has provision for adjustment according to the speed of the film in use, and (if specially designed for motion picture work) the running speed of the camera. When set according to the pointer reading, the calculator then indicates the correct exposure. Alternatively, the scale itself may be adjustable for film speeds and directly calibrated in lens apertures.

Modern meters are sensitive to a wide range of light intensities from a very low level upwards. Some models have two measuring ranges, controlled by a suitable screen, and with two scales for lower and higher light intensities.

Most meters can be used for both still photography and motion-picture work. Models specially calibrated for cine cameras are also available, and are usually more convenient and quicker in operation, as less calculation is involved.

However, any reliable meter can be used with a cine camera. After adjusting for film speed and taking a reading on the subject, the lens aperture is read off opposite the shutter speed corresponding to the camera running speed, i.e. usually 1/30 to 1/40 second (see page 130).

From the practical point of view there are two main methods

of taking meter readings: we can measure the light reflected from the subject, or the light falling on it. These methods are accordingly known as reflected light and incident light readings.

Reflected Light Measurement

To take a reflected light reading, hold the meter near the camera. For medium and close shots not presenting strong contrasts aim the meter simply towards the centre of the subject. Thus the meter will point in the same direction as the camera lens: downwards when filming a kitten at play on the floor: upwards for apple-blossom in the orchard. As a general rule correct aperture readings are obtained on average subjects if the meter is held at a distance from the subject equal to the subject's own height.

For medium and close shots with strong contrasts of light and shade, set the aperture so as to give correct exposure to the part of the scene where important action is taking place. If children dressed in light-toned clothes are seen against a background of dark foliage, it is the game they are playing that matters, while the way in which the setting will be reproduced is of less importance.

For distant shots the lighting conditions at the meter position should be the same as in the subject area. This is the case with open landscapes. But sometimes conditions differ. For instance you may be filming a distant sunlit landscape and using a doorway or branch of a tree as a foreground "frame". If you take a meter reading from the camera position the photo-electric cell will be in shadow and the reading will be much too low for the distant subject. The remedy is easy: take one reading in the shade and a second in open sunshine, and set the lens aperture midway between the two. If the shadow predominates, open up the lens rather more; if the sunlit parts of the scene are more important, stop down a little.

In case of doubt, remember that with reversal film slight under-exposure is preferable to slight over-exposure. Dark scenes are more pleasing to look at than the pale, washed out pictures that result from over-exposure, and are also easier to compensate in processing.

With average subjects reflected light readings give perfectly reliable results, and this is the most convenient way of using the meter.

Incident Light Measurement

In this case the meter does not measure the light reflected by the subject, but instead that which falls upon it and its surroundings. Before taking a reading of this kind, the meter must be adapted by placing a translucent plastic cover (supplied with most modern meters) over the cell.

After deciding on the camera position, take up a position near the subject. In the case of a distant landscape or other inaccessible subject stand so that the same light falls upon the meter as on the scene itself. Point the meter towards the intended camera position (not the sun), aiming it so that the plastic cover receives light from the same angle as the view to be filmed.

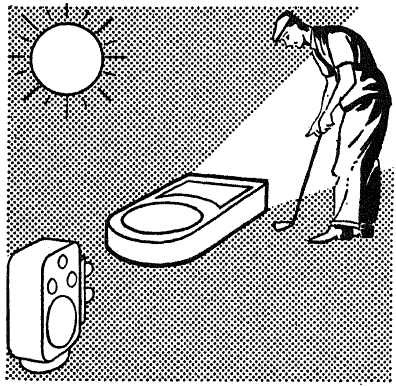
When you are unable to move from your position at all, as may happen in the middle of a crowd, and the action to be filmed is taking place in different lighting, it may be advisable to take a normal reflected light reading. When shooting from a sunlit position into shadow, arrange to cast a shadow over the meter and obtain an incident light reading in this manner.

The advantage of incident light measurement is that the exposure value obtained depends only on the lighting level of the subject, and not on relative proportions of light and dark. Areas of similar brightness are thus reproduced with constant tone values; e.g. a flesh tone will always be equally light. This is of great value with reversal film, since the method in particular ensures constant exposure of the important light tones.

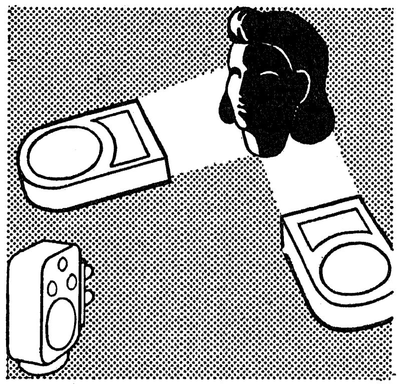
Special Cases

Before making a panoramic or "panning" shot with the camera over a scene with wide lighting variations, first swing the meter round over the scene and watch the movement of the pointer. If the tone range is very wide, choose an aperture midway between the extreme readings.

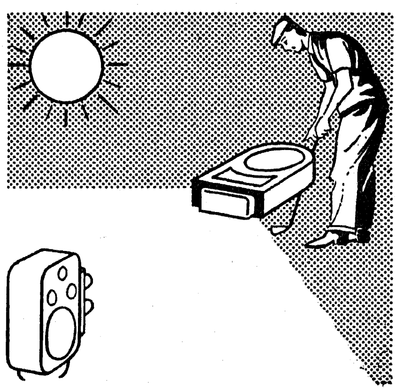
For normal readings point the meter at the subject from the camera position. For accurate results with close shots hold the meter nearer the subject than the camera position. Most meters have a wider acceptance angle than a standard cine camera lens and readings may be influenced by features which are outside the camera's field of view. Moving in closer helps to avoid exposure errors arising from this cause.



With subjects of strong contrasts of light and shade take separate readings from the highlight and shadow areas. If contrast is not excessive, an aperture midway between those obtained from the two readings should give an acceptable result. If the readings are more than 2 stops apart, the contrast is too great for a faithful rendering on colour film. Contrast can sometimes be reduced by a change of camera angle or use of a reflector to lighten the shadows.



Exposure can also be determined by measuring the light falling on the subject. Most meters have an incident light attachment, which is placed in position over the cell so that the latter is evenly affected by light from a wide area. The meter is held at the subject position and facing the camera, when it receives light from the same angle as the subject. This ensures that the reading is not affected by extraneous features of the scene, as may happen when the meter faces the subject.



Often it will be found advisable to set the aperture so as to obtain correct exposure of the final sector of the panorama, which will remain longest on the screen and thus leave the strongest impression on the audience.

When shooting against the light on black-and-white film, it is best to give sufficient exposure to obtain at least some detail in the shadow. This of course does not necessarily apply when a silhouette effect is required.

When taking a reflected light reading of a back-lit subject it is important to shade the meter from the direct rays of the sun. Failure to do so will produce a false reading and heavy under-exposure. An incident light reading in this case is of course taken with the meter facing *away* from the main light source.

When filming a tracking shot (page 47) it is often difficult to find an aperture that will be correct throughout the duration of the shot. The best solution when variations are not extreme is to choose an average setting and use it throughout. With wide variations in subject or lighting it may be necessary to adjust the aperture during the shot.

Exposure meters are also valuable aids to indoor filming, but as the light is much weaker and generally concentrated on the subject only, a different technique is required when taking readings (see page 108).

Meter and Camera Variations

Though meters are always carefully tested by the manufacturer before release, it is advisable to make sure that your meter and camera settings are suitably matched.

There are three factors which may impair the accuracy of meter readings:

1. *Camera running speed.* This may be slower or faster than the marking on the speed control.

2. *Shutter speed.* Even if the camera is running correctly at 16 f.p.s., the exposure time with certain cameras is sufficiently outside the range 1/30 to 1/40 second to have an appreciable effect on exposure.

3. *Meter variations.* Meters of different makes do not always

give the same exposure readings for identical lighting conditions.

In the event of such variations being cumulative, e.g. camera running faster than the marked speed of 16 f.p.s. and the meter indicating a smaller stop than actually required, or the reverse, a considerable exposure error could result.

It is therefore advisable to make some preliminary tests in order to calibrate the meter. The procedure is quite simple.

Calibrating the Meter

Load the camera with a standard black-and-white film to which you are accustomed. Choose a series of outdoor subjects, e.g. in sunlight without excessive contrast; in the shade, and at different distances. Arrange to shoot each scene three times. Take meter readings of each subject, and set the lens aperture as follows:

Test 1. One stop larger than the meter reading.
Test 2. Set lens aperture on actual meter reading.
Test 3. One stop smaller than the meter reading.

When making exposure tests with colour film (page 85), which is more sensitive to exposure variations than black-and-white film, make the differences between tests 1 and 2, and 2 and 3, only half a stop each time.

Make a point of shooting a few blank frames between each test, by running the camera very briefly with the lens covered. This makes identification of the individual tests much easier.

There is no need to use a whole spool or magazine on a test of this kind; a few feet are quite sufficient for the purpose.

When the film comes back from processing, it is easy to identify the scenes that have been correctly exposed, and to ascertain whether the meter reading can be used without alteration.

If one test exposure at *f*11 gives a better result than that taken at *f* 8, it is clear that for that particular subject the meter indicated too large an aperture. And if the same applies to the tests taken on all subjects, you can safely conclude that the meter reading is one stop "slow" for all purposes.

If the tests show a consistent error one way or the other, the easiest way to avoid the need for further calculation is to alter the film speed setting on the meter; adjust it for a slower film if the meter consistently gives too small an aperture; for a faster if the aperture reading is too large.

Care and Maintenance

While an exposure meter is not unduly fragile, it is a precision instrument and should be treated accordingly. A bad knock, or a fall on to a hard surface, can cause serious damage. Never leave the meter lying in the sun, as this will effect the life of the photo-electric cell. Exposure to grit and sand should also be avoided. A case is essential, the ever-ready type being convenient in use.

After many years' service the photo-electric cell may lose some of its sensitivity. It is therefore advisable to check the readings from time to time by comparison with a brand new meter, choosing subjects with widely differing lighting conditions. Sometimes old and new instruments will react identically to average light intensity, but quite differently to weak light.

As a general rule, when the meter is laid down flat, the pointer should return to zero when the cell is covered. Some meters are fitted with an adjusting screw for re-setting the pointer to zero when necessary. If in doubt on this point, get a dealer to advise you.

If after comparative tests with a new meter the reliability of the old model still appears doubtful, have it checked by the manufacturer or his agent. In view of the importance of the instrument, it is good practice in any case to have a meter completely overhauled every three or four years.

Second-hand meters, unless offered for sale by firms or persons of repute, are doubtful bargains.

Filming in Colour

MOVIE-MAKING in colour is not much more difficult than shooting with black-and-white film. In some ways it is even easier to use than black-and-white, because the colours in the subject when reproduced naturally, provide their own contrasts; whereas monochrome film may record different colours as similar shades of neutral grey.

When shooting in black-and-white, the contrasts necessary to render subject and action clearly visible have to be obtained by placing dark figures against a light background, or vice versa. If foreground and background are too similar in tone the subject appears lost in its surroundings. So if it is a question of filming a shooting party in wooded country, the cameraman will have to get his sportsmen at the edge of a wood, or in a clearing, so that they are clearly seen in silhouette, not lost against the foliage.

With colour film it is quite a different matter: a few bright colours in the clothing will soon show up the figures against the greens or browns of the natural surroundings, even when they are some distance away.

Two Points of Handling

~~Particular care is~~ needed when loading the camera with colour film, and when reloading double-eight film for the second run. Work in very subdued light to avoid fogging the film. Such fogging is liable to produce an orange-coloured veil over the image which will necessitate scrapping the affected footage at the editing stage.

With colour film an efficient lens-hood is essential, especially

when filming side and back-lit subjects. The hood should be capable of being fitted in front of any filters required.

Exposure

In most respects shooting in colour is easy. But special care is needed with exposure, which must be accurate to within half a stop. There is much less latitude for error than with black-and-white film, and strong contrasts of light and shade (as distinct from *colour* contrasts) must be avoided.

An exposure meter is therefore virtually indispensable. Its use does not greatly differ from the procedure with black-and-white film, though a few points merit special attention.

Reflected Light Measurement

For subjects lit from the front, reflected light readings are perfectly satisfactory, as the lighting is uniform. But when the subject is lit from the side (page 90) it is advisable to take separate readings of the highlights and shadows, to ensure that the contrast is not excessive. If the respective readings correspond to exposures more than one stop apart, it is best to reduce the contrast by altering the camera angle.

Aim the exposure meter in the same general direction as the camera lens. When the subject is a landscape with clear sky and the camera is shooting straight ahead, the meter can also be held level, for blue sky is not appreciably brighter than an average landscape. But when the sky is overcast, lighting conditions change considerably. To avoid under-exposure of the landscape itself the meter should then be pointed slightly downwards.

The exposure reading obtained may sometimes need modification, especially with near subjects or figures appreciably darker (or lighter) than their surroundings. Thus when a view includes people more than about 40 feet from the camera, the main factor to be considered will be the brightness of the background and the exposure reading is correct as it stands. When the figures are closer, dark clothes etc. will need more exposure—perhaps half a stop larger. Whenever possible, how-

ever, take a close-up reading, holding the meter near the subject itself, so that its angle of view excludes the surroundings.

Shooting against the light is relatively easy with black-and-white film, but more difficult with colour film. The first step is to measure subject contrast with a meter; if the difference between the light and dark parts is excessive, a mean aperture setting will be useless owing to the inability of the film to record extremes of brightness. The only solution will be to expose for the highlights and aim at a silhouette effect.

Incident Light Readings

Incident light readings are specially valuable with reversal colour film since they ensure that the light tones always receive the same exposure and thus reproduce correctly. Colour distortions in bright areas are much more disturbing than in dark ones—in fact an excessively red or greenish tone is glaringly obvious while a completely wrong brown may pass without being noticed.

The procedure for incident light readings is the same as with black-and-white film. When, however, the surroundings of the subject are very dark and the light parts small, the aperture should be opened half a stop; close the aperture if there is no dark tone at all of importance in the scene.

If in doubt as to the correct aperture, it is better to err on the side of under-exposure. Shots which are slightly on the dark side are preferable to the washed-out colours resulting from over-exposure. If a subject is of exceptional interest, it is well worth while to shoot it twice at different apertures.

Learning to "See" Colour

Modern colour films are able to reproduce the colours of nature with remarkable fidelity. Yet it often happens that a person viewing a colour film will exclaim: "Very pretty, but the colours were not really like that!"

But as likely as not, it is the viewer, not the film, who is at fault. There is a tendency to associate certain objects with certain colours, and to assume that the colour never varies,

irrespective of the surroundings and lighting. The man in the street expects a girl's white dress to look white on the screen in all circumstances. If the girl is filmed in neutral toned surroundings near midday in the bright sunlight, the result will be correct. But if the shot was taken early or late in the day, the dress may well be tinged with pale red or orange from the sun.

Conversely, in a scene exposed in the shade under a clear blue sky, the tone will be a bluish one.

The actual colours of a subject are affected not only by the light, but also by the colours of the surroundings, which may be outside the picture area. Thus if the girl is sitting on a green lawn, the white dress may have a greenish tinge or *cast* owing to the light reflected up from the ground. Or again, you might be sitting inside a red-painted motor coach and filming preparations for its departure. The driver in a white overall walks towards the vehicle, and as he does so the overall becomes tinged with red reflected from the coach. You may not notice it at the time, but when the film is projected the effect is unexpected.

A shot taken from outside, showing the vehicle and its colour, provides the necessary visual explanation in such a case; the audience sees the source of the colour and the effect will pass unnoticed.

The first step when starting colour filming is therefore to learn to look at one's surroundings with fresh eyes, and make a mental note of the actual colouring, under different conditions, of familiar objects. It will often be found that preconceived ideas and recollections of colours are quite mistaken.

Another important factor affecting the viewer's assessment of a projected colour image is the narrow field of view of the camera, compared to that of the human eye. Unless the camera is fitted with an anamorphic lens attachment a landscape, for example, is usually only partially shown on the screen. The camera may pan across it, or the scene may be shown in separate shots, but in either case the audience is forced to concentrate on the distant view, whereas an observer at the camera station could have examined the whole scene in a single glance.

Colour Composition

Composing a colour shot is a question of good taste and a sense of harmony. These are difficult concepts to explain in words but they can be acquired and developed by careful observation of intended subjects, and choice of the best viewpoint, lighting and colour arrangement. When the film is projected each scene should then be examined in detail and the reasons for success or failure carefully noted. Perhaps this sounds too much like hard work, but the time spent in carrying out the tests will be more than repaid by the lessons learned.

For example, a film may show that it is no use trying to shoot late in the evening; that if a particular shot is dominated by a single light-toned colour, it needs to be offset by a darker tone in order to avoid the impression of over-exposure. Then again it will be found that certain colours do not go well in juxtaposition, but are better seen in separate shots. Trial and error is the best way to learn.

Effective colour contrasts can be obtained by the choice of two complementary hues, provided that they are used with discretion. The brighter one should occupy a relatively small area of the picture. Examples of such compositions are the red cabin of a funicular railway seen against a tree-covered mountain; a girl in a blue dress admiring a bed of red tulips; or a boat with an orange or red sail in an empty seascape.

Such an arrangement of contrasting colours is for occasional use only. The majority of shots in a film should rely on harmony of colours of similar hue and in pastel shades, with one or two bold and saturated tones standing out. For instance, a patch of sunlight on a light brown tree trunk will harmonize well with the more subdued greens, yellows, and browns of a wood or a copse, yet stand out quite distinctly.

Colour Round the Clock

Provided that the right aperture setting is used, successful shots can be taken with colour film at almost any time from sunrise to sunset, and in town or country. Sometimes when the light is unusual in quality a few feet of film shot "just to see

what comes out" produce results exceeding all expectations.

It might therefore seem that colour film can be exposed with confidence, whatever the time of day and prevailing lighting conditions, and without special precautions.

Modern colour emulsions do have a certain latitude which enables liberties to be taken. At the same time the quality of the results and fidelity of the colour rendering obtained are governed by the composition of the light reaching the subject. And the light varies from hour to hour throughout the day.

Thus a shot taken when the sun is low in the sky will have an over-all orange tinge. If the scene is an ancient town or building, the warm tones of sunlight striking the walls will not look particularly unusual. But in a close-up of a human face by the same lighting, the reddish flesh tones would seem unnatural, and the result will be much less acceptable. All this means that some subjects can be filmed at almost any time of day, but others should not be tackled too early or late. Close-ups of people's faces fall into the latter category, for we all have our own fixed idea of how the human complexion should look.

As far as possible, avoid shooting too early and too late in the day. There must be one exception to this recommendation, for otherwise it would be impossible to film a sunset, which can produce very fine results. It is a good idea to finish the shot with a very slow fade-out; this produces a very pleasant variation in tone values.

Choice of Lighting

The lighting contrast outdoors depends on the position of the sun relative to the subject. When the subject directly faces the sun, contrast and modelling are at their lowest. And as colour film is unable to give a satisfactory rendering when the lighting contrast is high, film manufacturers usually recommend frontal lighting.

While frontal lighting is easiest to handle for the beginner, it is by no means the only possible arrangement. When the light comes from one side, it picks out the texture and adds modelling. The scene then becomes considerably more alive and gains depth. With the sun more or less behind the subject, the

main areas become black masses outlined by brilliant rims of light.

When experimenting with side- and back-lit subjects, highlight and shadow areas must be kept within the contrast range of the film, if a true colour and tone rendering of both is required. For this purpose, reflected light readings (page 86) can be taken of both. If the exposure required differs by more than $1\frac{1}{2}$ stops, something will have to be sacrificed; either shadow, or highlight detail.

One drawback of frontal lighting, suitable as it is for distant scenes, is that in medium and close shots of people the faces appear screwed up and tense to avoid the direct glare of the sun. The best results in such cases are obtained by shooting when the sun is slightly obscured, and arranging for it to shine on the subject from the side. With bright sun shining from the side, it may be possible to reduce its intensity in big close-ups and thus soften the contrast, by interposing a fine piece of cloth, e.g. a handkerchief, between the sun and the subject.

All the same, while hard lighting should be avoided, so should brightly-lit subjects containing large unbroken areas of light-toned colours. There is not only a danger of over-exposure, but the scene will lack character. Try to introduce some contrasting element; a small splash of different colour will serve to add life.

Using Reflectors

There are certain situations in which you can safely film with side-lighting or even against the light. At the seaside, in snow, or when white walls or pavements are present, the large natural reflecting areas that these features provide diffuse the light in all directions, thus lighting up the shadows adequately.

If no such natural reflectors are available on the spot, it will be necessary to proceed with caution. But with fairly close shots involving a small subject area, a portable reflecting screen can be used—in emergency a large handkerchief or sheet of newspaper. Or, follow the professionals and use boards either painted white or covered with tinfoil; they are of course easier to handle and carry around if you are working in a team.

The state of the sky can be quite important to the over-all colour rendering. With monochrome film, clouds merely provide a pictorial element which may help in composing the shot. In colour, too, cloud effects can be very satisfying; but in addition the clouds influence the colour rendering of the scene itself.

With a clear sky, the light comes both from the sun and the blue sky. This combination produces lighting conditions that are particularly favourable for colour film. Shadow areas do, however, tend to show a bluish tinge due to reflected light from the blue sky.

When the sun is slightly obscured, the light is, paradoxically, even more suitable as it is better diffused and produces results of unexpected beauty. Colours come out brighter than would have been thought from their appearance at the time of taking the shot. Furthermore, the shadow areas are considerably lightened.

When there are large white clouds in the sky, they reflect the light of the sun into the shadows, partly neutralizing the bluish cast due to the reflected blue sky light.

When the sky is overcast, conditions for filming are unfavourable. The lighting remains flat and uninteresting, no matter what camera position is adopted; the subject loses depth and colours are dull with a predominance of bluish tones.

Apart from its influence on the colour rendering, the sky itself can form an important element in the composition of a colour shot. The blue which varies from hour to hour and according to the camera angle and the latitude of the particular location, forms a backcloth which a movie-maker of discrimination can turn to good account.

But where close shots rather than landscape effects are concerned, use colour with restraint; it will be better in such cases to look for soft hues, and avoid unpleasant clashes.

To observe how the blue of the sky varies according to the viewing angle it is only necessary to take up a position in open country; the change of colour will be clearly seen from different

angles. This is a point to bear in mind, and when shooting against the light the sky should not occupy more than a small part of the frame area; the blue is degraded and looks insipid from this angle.

Panoramas

Distant panoramic shots should be filmed at 24 f.p.s. and from a tripod. The distant scene will appear clearer and colours will be brighter if the exposure is made after rain.

For panoramic shots of closer subjects the camera should be pivoted still more slowly than with black-and-white film. Swing the camera in the same direction as any significant movement in the subject.

The jerky effect resulting from panning too fast, or against subject movement, becomes intolerable with colour film. The camera should therefore only be panned at all when there is no other way of getting the shot.

Filters for Colour Film

Filters designed for use with colour film are quite distinct from those intended for black-and-white (page 69), which must on no account be used with colour emulsions. Otherwise the image will take on the over-all colour of the filter used.

Two filters that may be needed in daylight with colour film are an ultra-violet and a *haze* filter. The ultra-violet filter appears colourless, but holds back ultra-violet radiation. The haze filter may be pale salmon or pink in colour.

The purpose of these filters is to eliminate the bluish over-all cast which may appear in distant landscapes, sea and lakeside views, snow scenes, shots filmed from aeroplanes in flight, and those taken in the shade or in overcast weather. The effect increases with the depth of the filter; thus the ultra-violet filter only cuts out the blueness resulting from excess ultra-violet radiation—which is not even visible in nature. The haze filters on the other hand correct visible blue casts, as for instance the blueness of a scene shot in the shade and lit only by the blue sky.

Landscape shots often have a predominance of green from grass and foliage. A haze filter tends to turn these greens yellow; but without it the horizon might register as blue-green—a shade that is even less pleasing.

Neither ultra-violet nor haze filters require any increase of exposure.

ULTRA-VIOLET AND HAZE FILTERS

Filter	*Ansco*	*Gevaert*	*Ilford*	*Wratten*
Ultra-violet	UV15	UV-1	No. 805(Q)	—
Light haze	UV16	CTO-2	—	No. 1A
Stronger haze	—	CTO-4	Aviol	No. 2B

The Polarizing Filter

With colour film a polarizing filter (page 74) can be used to control the brightness of the rendering of blue sky without affecting the colour or the rendering of the rest of the scene. An optimum effect of deep blue is obtained when the camera points at an angle of 90 degrees to the sun. If the filter mount can be rotated and a lever is fitted for the purpose, it is possible to turn the filter gently while the camera is running; this makes the sky appear lighter or darker blue without in any way affecting other colour values.

This filter is also very useful for cutting out atmospheric haze which obscures detail in distant shots.

To find the correct orientation hold the filter up to the eye and rotate it until the desired result is obtained. Then make note of the index mark, and place the filter on the camera lens in the same orientation. An increase of exposure of between 1 and 1½ stops is usually required.

Filming Indoors

OUTDOORS, the amateur movie-maker can manage quite well with nothing but a camera. Some people are put off indoor filming by the idea that costly extra equipment is necessary. This is not the case. But certain questions do at once spring to mind: Can the ordinary lighting installation of a house or flat be used for filming? How should the lamps be arranged to get the best effects? How is an exposure meter handled indoors? Is it very difficult to film in colour? Let us look into them.

Using Daylight

We are of course concerned with filming indoors; but before going into the question of artificial light, it is worth bearing in mind that it is sometimes possible, if a room has large windows, to film by daylight alone.

Such a room must be well lit from outside; it should also have white or light-toned walls to provide the maximum possible reflection. Filming should of course take place when the light is brightest, but keep any part of the room that is in direct sunlight out of the picture area. Otherwise contrasts will be excessive. In this connexion, a projection screen may come in very handy as an improvised reflector to lighten the shadows. The foregoing procedure can be used with all types of film, including colour stock.

If daylight alone is not bright enough for shooting when using fast black-and-white film, you may be able to get enough light by putting 100 or 150 watt bulbs in the ordinary light fittings to supplement daylight. With daylight type colour film, the only type of lamp which can be used in conjunction

with daylight is a special blue-tinted Photoflood bulb (page 95). Any other type of incandescent lamp gives a light that is much too yellow for a proper colour rendering.

If the action filmed is supposed to be taking place at night, the windows themselves must not appear in the picture, in order not to give the game away.

Photoflood Lamps

The most convenient and inexpensive lamps for occasional interior filming are Photoflood bulbs. They are produced by the principal manufacturers of domestic bulbs, and are obtainable from photographic dealers. Photoflood bulbs are overrun (i.e. they burn at a higher temperature), so that the filament emits a much brighter light than normal. This increased output is gained at the expense of long life, but with care, and by using series-parallel switching (page 100), bulbs can be used to expose a considerable footage of film.

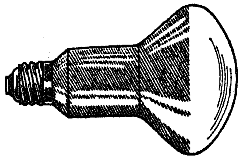
Two types of Photoflood bulb are available: the cheapest, the No. 1, is rated at 275 watts but gives an effective light output equivalent to about 800 watts of ordinary lighting. It has a standard bayonet cap, enabling it to be used in normal household sockets. The average life of the No. 1 type when burning continuously is 2 hours.

The No. 2 Photoflood is rated at 500 watts and gives an effective light output equivalent to 1,500 watts of ordinary lighting. It is available with either bayonet or Edison screw cap and has an average life of 6–10 hours.

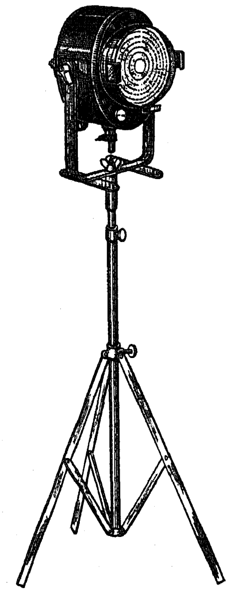
Studio Lamps

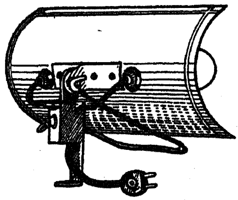
For frequent or continuous indoor filming studio (Photopearl and similar) lamps, though more expensive in first cost than Photofloods, may be more satisfactory in the long run. Most Photopearl lamps are rated at 500 watts, have an Edison screw cap and an average life of 100 hours. Other studio lamps are rated from 1,000 watts upwards.

Some manufacturers supply both Photoflood and Photopearl type lamps with a bulb internally silvered on one side, which

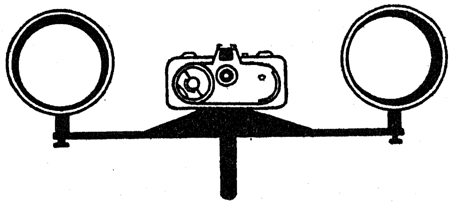


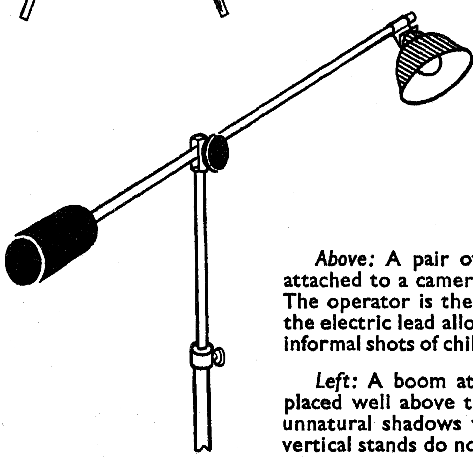
Photoflood lamps are available with a silvered interior, obviating the need for a separate reflector. The type illustrated has an Edison screw cap. Other lamps are available with the familiar household bayonet cap, but the E.S. fitting is used for higher wattages.





Left: Spotlights are essential for serious work. They range in power from 200 to 2,000 watts. *Above:* This reflector has a built-in dimmer. *Right:* Small units can be fixed in place by a spring clamp.





Above: A pair of reflectors on an arm can be attached to a camera to form a single mobile unit. The operator is then free to move about as far as the electric lead allows, which is an advantage with informal shots of children at play.

Left: A boom attachment enables lamps to be placed well above the actors' heads, which avoids unnatural shadows when filming adults. Ordinary vertical stands do not usually extend beyond 4–5 ft.

acts as a built-in reflector and dispenses with the need for a separate reflector.

All types of lamp described above are made for voltages between 100 and 250 volts, and the rating should of course be chosen to suit the available mains supply.

Reflectors

Unless the lamps have built-in reflectors (see above), they should be fitted in some kind of reflector in order to utilize their power to the best advantage.

There are many types of reflector on the market. Before selecting one it is advisable to pay particular attention to the quality of materials and workmanship, the shape and the internal finish. These factors can make a difference, in terms of illumination, of more than one whole stop on the lens diaphragm between one model and another.

Some reflectors are designed to stand on table or floor, or hang from a picture rail. Others can be clipped to a chair-back, an open drawer or a door-frame. Whichever type is preferred, it is important to ensure that the swivel mount is robust enough not to move out of adjustment under its own weight.

If it is only desired to cover a limited field of view, a pair of reflectors can conveniently be mounted on a bar and attached to the camera as a unit, in the same way as flashguns are used with snapshot cameras. Ready-made lighting units of this type are available commercially, or can be made up by any handyman.

The advantages of this arrangement are that the light is always ready to hand with the camera, no assistant being required for the purpose, and any subject facing the camera is evenly illuminated. The cameraman also has considerable freedom of movement, which can be of great value with unrehearsed incidents, meetings, receptions, children's parties etc.

But as the subject is necessarily lit from the front, there is some loss of modelling due to the flat lighting, and artistic effects cannot be expected. In particular special attention is needed to avoid over-exposing faces in close shots and close-ups which will make the persons involved appear unduly pale.

A good way of mitigating the flatness of the lighting is to use two lamps of different power, e.g. 250 and 500 watts.

Reflectors for photographic lamps are supplied with either bayonet (B.C.) or Edison screw (E.S.) sockets. So make sure that your sockets match the type of bulb that you intend to use.

Connecting Up the Lamps

When using high-powered lamps it is important not to overload the electrical system, or the fuses will blow out.

Many households have separate 5-ampere lighting and 15-ampere power circuits. To decide which circuit to use, first calculate the total amperage of your equipment. To obtain the amperage, divide the wattage by the mains voltage.

For instance, with two No. 1 Photofloods, the total wattage will be $275 \times 2 = 550$. On a 220 volt mains, the amperage is $550 \div 220$ or about 2.5. So the lamps can safely be used on one 5-ampere lighting circuit.

If the total amperage exceeds 5, the lamps can either be connected on different 5-ampere circuits so as to distribute the load between different fuses, or a single 15-ampere circuit (total permissible wattage at 220 volts is 3,350 watts or 3.3 kilowatts, equal to five No. 1 Photofloods) can be used. It is important to distinguish between individual lighting and power outlets, and the *circuits* which they comprise. Each *circuit* has its own fuse, but may include several lighting or power points. Therefore when distributing a load, ensure that the points chosen for the connexions are on *different circuits*, i.e. have *separate fuses.* Circuits can easily be identified by removing fuses one at a time and noting which points go dead as a result.

Earthing and Switching

Most modern households are now fitted with three-pin sockets throughout. This enables the metal parts of all appliances to be connected to earth, which provides a safeguard against electrical shocks (they can be fatal) in the event of a breakdown of the insulation or of a live wire touching a metal part. Better quality electrical equipment is fitted with an earthing terminal,

and this should always be connected to the earth pin of a three-pin plug. Three-core wiring has one wire coloured green, which should be connected to earth.

Where a switch is incorporated in the electrical fittings, and the mains current is alternating, it should be so connected that it interrupts the circuit on the *line* (L), not the *neutral* (N) wire. This ensures that the apparatus is completely "dead", or free of electricity, when switched off.

When several photographic lamps are used frequently, it is an advantage to have a junction box comprising a mains input, a switch or switches, and sufficient output sockets for the number of lamps. Such a box is easy to make up, and obviates the need for multiple adapters and trailing wires.

If long cables, either to or from a junction box, are unavoidable, roll them up on a drum whenever they are not fully laid out. That prevents tangles and accidents.

Series-Parallel Switching

The rather limited life of Photoflood lamps can be considerably extended by running them at reduced voltage whenever the full power is not required—e.g. for setting up and arranging the lighting.

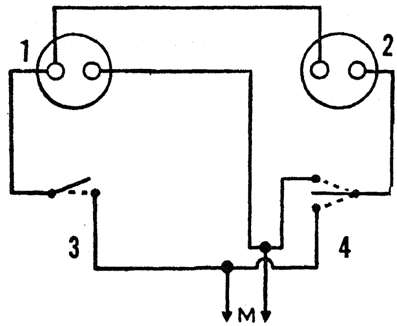
The simplest way of doing that is to connect two Photofloods in series; that is one wire from one lamp joined to one wire from the other lamp, and the two remaining wires taken to the mains. As a result each lamp only takes half its normal current (and is only one-quarter as bright). Burning at this rate does not affect the life of the lamp.

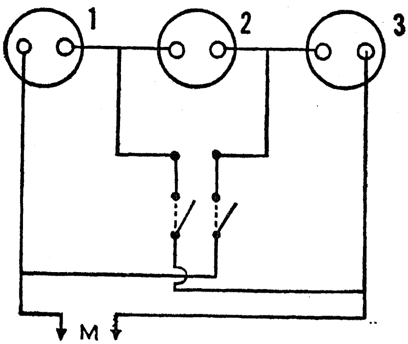
For the actual exposure, also for meter readings, the lamps are re-connected in parallel (each being joined to both sides of the mains) so as to burn at full power.

The change-over process can be controlled by one or two switches with a suitable lamp circuit. This permits the lamps to be switched from full power to half power or vice versa instantly.

When wiring up two (or more) Photofloods for series-parallel operation, the two halves of the circuit must balance. In other words do not combine a Photoflood No. 1 with a No. 2;

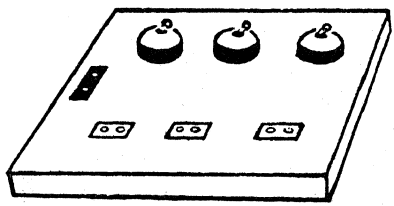
Right: Series-parallel circuit diagram for two Photoflood lamps. I and 2, lamp sockets. 3 and 4, switches (usually combined in one housing). M, mains lead. Lamps must be of identical characteristics. In the series position (switch 3 open, switch 4 down) lamps burn at half power and life is increased. Full power position (switch 3 shut, switch 4 up) is used when lamps are warmed up.

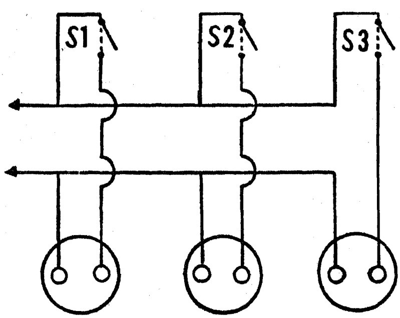




Left: Series-parallel circuit diagram for three lamps. I, 2, and 3. Lamp sockets. M. Mains lead. With switch contacts open, lamps are connected in series; with switch closed, lamps are in parallel. When using three No. I type Photofloods, make sure that the fuse in the mains circuit will carry at least 5 amps. Connect three type No. 2 Photofloods to a "power" (13 or 15 amp.) circuit.

Right: A distribution board is almost essential for any but the most modest lighting arrangement. SI, S2, S3 are switches and all outlets are in parallel. A board can be made if desired to incorporate series-parallel switching as shown at the top of the page. When the equipment has an earth wire, use 3-pin plugs and sockets throughout, connect the earth (green) wire to the large (E) pin, and the live (red) and neutral (black) wires to terminals marked L and N respectively. Leads *from* mains must terminate in a *female* socket, to fit *male* plugs on equipment leads. To connect board to mains, use several yards of heavy duty 3-core cable terminating in a 13 or 15 amp. plug.





it has to be either a No. 1 with a No. 1, or a No. 2 with a No. 2, or *two* No. 1 bulbs with one No. 2.

Whenever Photoflood lamps are first switched on, they should be switched to half power, and only then to full power. This allows the lamp filament to warm up in two stages and further increases the life of the lamp.

Colour and Artificial Light

Artificial light type colour film is essential for indoor filming with lamps. Most artificial light type films are balanced for Photoflood lamps (type A), a few professional films are balanced for Photopearl or similar studio lighting.

The exact voltage at which the lamps burn is important with colour. Always use the lamps at the voltage marked on them. It may even be necessary to use a voltage stabilizer to compensate for fluctuations in the mains supply, which cause corresponding variations in the colour of the light. Such stabilizers are usually fitted with a voltmeter to enable a constant check to be kept on the supply.

Colour Temperature

The colour quality of a light source is usually defined in terms of its colour temperature. This is a physical concept which in practice is roughly related to the filament temperature of the lamp. The higher the colour temperature the more bluish the light; the lower the colour temperature, the richer it is in red.

The colour temperature can be ascertained by means of a special meter (not to be confused with an exposure meter, though the two instruments are sometimes combined in one). This measures the colour temperature of the light in degrees Kelvin (°K) and/or the *mired* value (the latter is an alternative, and sometimes more convenient, way of giving the same information).

Noon summer sunlight, for which daylight colour film is balanced, is 5,900°K. (170 mireds); Photoflood lamps burn at 3,400°K. (290 mireds), and Photopearl or similar studio lamps at 3,200°K. (310 mireds).

On some colour temperature meters the filters required for matching with different types of film (daylight, type A, etc.) can be read off.

Conversion Filters

As already indicated, it is important to use the correct type of film to match the light. A certain amount of compensation is, however, possible with the aid of filters if the right type of film is not available.

These filters are *colour conversion* filters.

Thus artificial light type film (type A) can also be used in daylight with a special pale orange filter. This needs a slight increase in exposure. The colour rendering is acceptable, and slightly "warmer" than when using daylight type emulsion. The conversion filter for type A film also acts as a haze filter. When using this combination of film and filter, no separate haze filter is therefore required. The actual filter required depends on the type of film and the exact colour temperature of the light.

Daylight colour film can also be exposed in Photoflood light. The blue conversion filter used requires a considerable increase of exposure (usually two stops), which means that powerful lighting is called for. In addition the colour rendering is less satisfactory than normally.

Generally conversion filters are thus to be regarded as a stand-by.

Compensating filters of considerably lower correction are also available when using type A film with 3200°K studio lamps (instead of Photofloods) or Photofloods with a film balanced for studio lamps. For really accurate colour rendering the light should therefore be checked with a colour temperature meter.

Whenever possible, use conversion filters of the same make as the film. Plain gelatine filters can be used unmounted in an emergency, but it is better to have them properly cemented between optical quality glasses. Gelatine filters must be stored away from heat and humidity, and should never be touched with the bare hands.

Light Source	*Filter Required*				*Open Lens by*
	Ansco	*Gevaert*	*Ilford*	*Wratten*	
**With Daylight Type Film (balanced for 5,900–6,000°K)*					
Photofloods (3400°K)	No. 10	CTB-8 +CTB-2	No. 351	80B	2 stops
Studio lamps (3200°K)	No. 10	CTB-12	—	—	2 stops
With Type A Film (balanced for 3400°K)					
Daylight	No. 11	CTO-8 +CTO-2	No. 161	85	½ stop
Studio lamps (3200°K)	—	CTB-2	No. 362	82A	½ stop
With Tungsten Film (balanced for 3200°K)					
Daylight	No. 11	CTO-12	No. 161	85B	½ stop
Photofloods	—	CTO-1	No. 171	81A	No change

*Colour rendering only approximately correct; for use mainly as a stand-by if no artificial light type film is available.

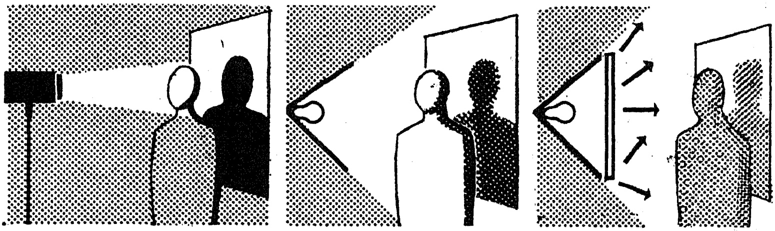
Arranging the Lights

Choose a room with light-toned walls and ceiling, the latter not too high. For informal family films featuring children, a bathroom or kitchen makes an excellent studio; the white walls will form an excellent reflector.

Amateurs often make the mistake of trying to use a wider indoor filming area than the lighting equipment at their disposal can cover. The result is that when a person moves away from a lamp, he or she is lost in gloom; and if he comes close, the middle tones are lost through under-exposure, and he looks deathly pale. Another common fault is to place the lamps too low. This, at any rate, is avoidable.

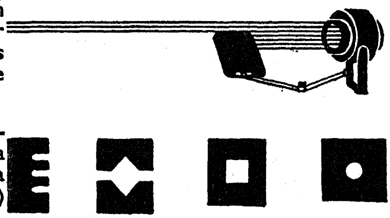
Concentrate therefore on adequate illumination of a modest area, even if this means frequent changes of camera angle and lighting set-up for the sake of variety. However, when shooting in *colour*, frequent changes of lighting on the same scene should be avoided, as they cause a change in colour balance.

Lighting for close-ups can be arranged as for portraiture, i.e. diffused lighting from one side of the camera, and a key light from the other. With all other shots it is best to aim at uniform diffused lighting over the whole set, so that the actors can move about freely without the risk of casting, or themselves

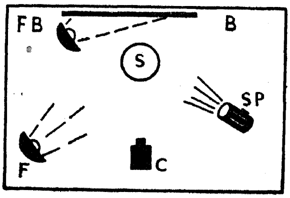


Above: Character of the light. Concentrated light in a near-parallel beam, such as from a spotlight (*left*), produces hard sharp shadows. Wider angle coverage given by a normal reflector (*centre*) still throws a shadow, but with softer appearance. A diffusing screen (*right*) spreads the light, reduces intensity and creates a soft effect with a minimum of shadow.

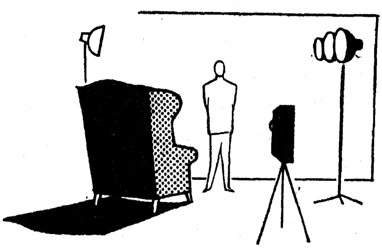
Right: Spotlight with beam-cutter on adjustable arm, and cut-out masks for shadow effects. The further the mask is from the light source, the sharper the outline of the projected shadow.

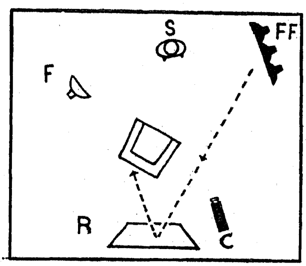


Below: Straightforward lighting set-up. The subject (S) is illuminated by a spot (SP) (the main or key light) and a flood (F) (fill-in). A separate flood (FB) illuminates the background (B).



Below: Alternative lighting arrangement. The main lighting floods (FF) and fill-in (F) may leave small local areas, such as the chair back in this set-up, in heavy shadow. If the use of an additional light is difficult, a white reflector board (R) can be positioned so that light from the bank of floods (FF) is reflected into the shadow area.





being obscured by, unwanted shadows. If this happens to your leading lady, the lighting cameraman will be blamed, and rightly!

It is also necessary to guard against shadows on the background appearing when actors move near to a wall. At least one lamp is therefore needed to light the background only, which in any case should not be left in darkness, to avoid excessive contrast with the rest of the picture.

Children and Glare

Mothers are sometimes worried that their children's eyes might suffer harm from looking straight into Photoflood bulbs. But there is no cause for alarm. Of course these bulbs seem very bright; but they are much weaker than sunlight. The only possible drawback to Photofloods is that the child may turn his or her head away as it is switched on, and so spoil the shot.

To get a small child to look towards the camera, the lamps can be placed laterally and outside his field of view. As the subject area in this case is limited, and light-toned, two or three lamps placed as suggested will still give enough light.

The No. 1 type Photoflood can be placed in a normal shaded lamp fitting for effect purposes, and itself appear in the picture. But overrun bulbs give off a considerable amount of heat and care must be taken to ensure that the shade is kept well clear of the bulb.

Using Spotlights

The value of spotlights for giving an artistic touch to motion-picture shots is not sufficiently appreciated by amateur movie-makers. Spotlights are fitted with special lamps, reflector and lens to concentrate the light, and can be adjusted to give a narrow or wider beam. Lamps are available from 100 watts up to 1,000 watts or more; the most useful types for amateur purposes being 500 watts for general purposes and 250 watts for close-ups and illumination of small objects such as toys and models.

Spotlight lamps and Photofloods usually burn at different

colour temperatures, so that caution is needed when using colour film. For effect purposes the slightly "warmer" tone of the spotlight may not be out of place, but where the spot is intended to merge into the over-all lighting, it is advisable to fit lamps burning at 3200°K throughout (controlled colour temperature type) and use the appropriate filter on the camera lens (page 104).

Spots are usually placed behind the subject, or to one side, and a telescopic stand is almost essential, as they are usually needed at a height of six feet or more.

Additional equipment available for spots includes a beam-cutter attachment which can be used to cut off any portion of the light so as to lighten or darken the shadows at will. Other masks of different shapes can be used to create special shadow effects on the background of the set.

Another way of simulating a window or grille pattern is to use a miniature slide (still) projector. A black paper mask with appropriate cut-out is mounted in a slide, and the image projected on to a light-toned wall within the camera field of view. For the effect to be clearly visible the projector lamp should have a power of at least 300 to 500 watts.

Wide-Angle Effects

The narrow acceptance angle of the standard cine lens is often inconvenient when shooting interiors. A wide-angle lens or attachment is therefore very useful. Caution is needed in wide-angle shooting to avoid exaggerated perspective effects—particularly converging verticals—when the camera is tilted upwards or downwards.

When the wide-angle lens or attachment is in use, it is important to remember to adjust the camera viewfinder accordingly. With some cameras this involves fitting a special supplementary lens on the finder front glass.

With no wide-angle lens available, it may be possible to take in a wider field of view by standing on a stool or step-ladder and shooting downwards. This also gives a fairly original viewpoint, but do not shoot the whole sequence from the same angle.

Another way of getting wide field is to film the reflection of the scene in a mirror. In this case the lens must be focused on the distance from the camera to the mirror *plus* the subject to the mirror.

Unwanted Reflections

A lens-hood is no less necessary for interiors than it is outdoors. Side lighting can cause reflections towards the camera; windows and glass doors in the subject area may reflect the image of a lamp, which looks most unprofessional on the screen.

Glare from reflections can be suppressed to some extent by using a polarizing filter (page 74). Its main drawback is that it cuts down further the limited amount of light available.

Tripods Indoors

There may be some excuse for not encumbering yourself with a tripod every time when filming outdoors, but there is none where interiors are concerned. A tripod should be regarded as absolutely essential.

Apart from rigidity, the most important feature required in a tripod for indoor use is security against collapse on slippery floors. Rubber ends to the feet are one insurance against accidents; another is a chain fixed so as to prevent the legs spreading apart beyond a certain point. Alternatively, the tripod can be stood on a piece of carpet.

Exposure Calculation

Most film manufacturers enclose a simplified guide with their products, giving recommended lens apertures when the subject is illuminated by 1 or 2 Photoflood lamps in reflectors. These guides are based on careful tests and are reasonably reliable. But they clearly cannot take into account all the factors affecting exposure under widely varying conditions. These factors can be classified as follows:

1. Tone values of the subject and its background.
2. Speed of the film.

3. Number and power of the lamps.
4. Efficiency of the reflectors.
5. Lamp-to-subject distance and angle of incidence of the light.

The Subject and its Background. A light-coloured subject requires less exposure (smaller aperture—larger *f*-number) than one of medium tone. Conversely, a dark subject requires more exposure (larger aperture—smaller *f*-number). The difference in each case in terms of lens aperture will be between ½ and 1 whole stop. This means that, according to the tone values of the subject, a range of as much as 2 whole stops may be involved.

Though background tone values do not affect the objective rendering of the foreground subject on the film, they have an important influence on the final result, and should be chosen to contrast with the foreground in both tone (for black-and-white film) and, when using colour film, in colour also.

Film Speed. A table of film speeds is given on page 65. Although these are daylight speeds, the relationship between different panchromatic films remains much the same in artificial light. For exposure meter settings the artificial light speed can usually be taken as 1–2° below the official daylight speed.

Lamps and Reflectors. Whatever lamp is used, the relative efficiency of a reflector (page 98) may make a difference of as much as 1 whole stop either way in exposure.

Lamp-to-Subject Distance. This is critical, since the light falls off rapidly with increasing distance. If the correct aperture with a single lamp at 3 feet were *f*4, and the lamp were then moved to 6 feet of the subject, then the distance would be doubled but the exposure would have to be increased *four times* for correct results. So the aperture at 6 feet must be *f*2 (not *f*2.8). To use the same aperture when the lamp-subject distance is doubled, *four times* as much light is therefore necessary.

Apart from the distance between lamps and subject, the direction from which they shine is important. Assuming that two lamps are used, the main lamp is usually placed so that its beam forms an angle of less than 45 degrees with an imaginary line between camera and subject. Any lamp shining at an angle of more than 45 degrees to the camera line gives less effective light: between 45 and 60 degrees this is reduced to one half,

between 60 and 70 degrees to one quarter. Beyond 70 degrees the effect of a lamp on the exposure is negligible.

This means that in order to double the effective light and so enable the lens aperture to be closed one full stop, the lamps must be doubled, placed at the same distance from the subject as the original pair, and at less than 45 degrees to the camera axis. If the second pair of lamps is placed at between 45 and 60 degrees, exposure can only be increased by half a stop; and between 60 and 70 degrees, by a quarter of a stop.

The table below gives suggested aperture settings for indoor filming in black-and-white and colour, using two No. 1 Photofloods as sole light source.

The figures apply to a camera speed 16 f.p.s.—shutter speed 1/30–1/40 second, in a light-toned room.

APERTURES USING TWO PHOTOFLOODS

Lamp-Subject Distance (feet)		*Films*			
		Fast	*Medium*	*Slow and Colour*	*Colour*
	BS	*29–31°*	*26–28°*	*24–25°*	*21–23°*
	ASA	*64–100*	*32–50*	*20–25*	*10–16*
1½		*f*16	*f*11	*f*8	*f*5.6
2½		*f*11	*f*8	*f*5.6	*f*4
3½		*f*8	*f*5.6	*f*4	*f*2.8
5		*f*5.6	*f*4	*f*2.8	*f*2
7		*f*4	*f*2.8	*f*1.9	*f*1.4
10		*f*2.8	*f*1.9	*f*1.4	—

Using an Exposure Meter

When using a meter for artificial light filming, the incident light method (page 80) is recommended.

A useful variant are the so-called highlight or key-tone methods. An artificial highlight—a sheet of white paper, handkerchief, or grey card—is placed in the subject position so that it receives the same illumination as that subject, and a *reflected light* reading taken from it. The relationship between the meter reading obtained and the correct aperture setting will depend on the reflecting power of the surface, and has to be found by experiment. If a plain white surface is used, the aperture setting will be about three stops larger (smaller *f*-number) than that indicated by the meter. If a grey card can be obtained

that reflects approximately 18 per cent of the incident light, the meter reading can be used unaltered.

The card should be at least 8 inches square, and the meter should be held from 6 to 8 inches away, care being taken not to cast a shadow of the meter itself on the card in the process.

Reflected light readings are less reliable for interiors than outdoors. It is difficult to get a correct reading from the camera position. The lighting, bright though it may be, is concentrated on a small area only, and the meter may well give much too low a reading. On the other hand if it is held close to a face or light-toned piece of clothing, an uncorrected highlight reading obtained from such features may well result in considerable under-exposure of the remainder of the subject and of the background.

For all kinds of meter readings care should be taken to ensure that the supplementary lights such as spots used for back lighting, and bedside and table lamps intended for inclusion in the scene, do not shine directly on the photo-electric cell. It is therefore a wise precaution to switch them off during the process.

Keeping a Record

The fact that a meter—when intelligently used—automatically indicates the appropriate exposure should not discourage the methodical worker from keeping a record of all details of the lighting set-up used on each occasion, i.e. power, positioning, and distance from the subject of each lamp. It will prove invaluable in the future.

Out and About at Night

Modern colour and high-speed black-and-white films, when used with fast lenses, even permit filming by the available light at night.

Illuminated advertisements offer wide scope to the movie-maker: branded products, cinemas, night-clubs and shop-windows are typical cases in point. Good results are obtainable with colour film if an aperture of *f*1.9 or 1.5 is available. Either

emulsion can be used, but the artificial light type is preferable.

Firework displays are best filmed with a camera incorporating a back winding mechanism. As it is impossible to compose the picture in advance, a good method is to wind back the film two or three times so as to superimpose several displays. With a subject of this nature there is no need to keep exact account of the number of frames exposed, or wound back.

Composition in firework subjects is improved if some feature such as an archway, an overhanging branch of a tree, or a silhouette view of spectators, can be included in the foreground.

If superimposition is used, the foreground must be static, and the camera mounted firmly on a tripod (it should be, in any case).

Looking for Subjects

AMATEUR MOVIES are first and foremost a pastime. But they can be something else too: an animated album of happy memories. As is the case in other creative pursuits, cinematography can be many things to many people; it all depends on individual temperament and taste. Every movie-maker sees things around him with different eyes; no two films are alike, and scope for individual treatment is unlimited.

Many enthusiasts regard a cine camera as just an ingenious contrivance for making a more lifelike record of incidents in family life than is possible with a still camera. And they get a great deal of fun out of their hobby at the time. But this somewhat casual approach to movie-making has its disadvantages. Often the enthusiast shoots reel after reel of anything that takes his fancy. Then he finds when the novelty has worn off that the material is not worth screening. There is a good reason for this: a central theme is lacking.

Look for a Theme

So see that even your shortest film has a single idea running through it; don't let it be a series of unconnected episodes filmed at random as they occurred. A film can deal with almost anything: baby's first steps; a picnic outing; or a car trip. The main thing is to have a subject and stick to it. Whatever the theme chosen, the story should follow the same pattern: introduction; main action; conclusion.

Though the kind of elaborate story found in professional feature films is beyond the scope of the amateur, episodes in ordinary life provide an inexhaustible source of material well

within your means. The best way to learn to make a film is to choose a subject with which you are quite familiar. Examples are: a day in the life of your children; your favourite sport; a shooting or fishing holiday; your job; the colours of the garden through the four seasons. Such subjects are within everyone's reach. The more ambitious worker may find his inspiration in a passage of literature, an episode remembered, a song or a poem.

Whether or not you have much natural aptitude for movie-making and can devote much time to it, there are two different ways of going about it: the easy way, and the not-so-easy.

The easy way is all very well for a start, but results are often poor, and give little encouragement to do better. The other way is simply a matter of taking trouble—trouble which will be amply repaid by results.

Preparing a Film

Once you have decided on your subject, it must be worked out in filmic terms—translated into pictures. It is a great mistake to imagine that this stage can be skipped and that it is only necessary to load the camera and start shooting. Amateurs are all too prone to reach for the camera before working out how to tell the story, and that is why so many films are incomplete and lacking in interest.

So do not improvise as you go along. Think the treatment out in advance, making a note of the principal sequences. The story may be light-hearted or serious; so the actors and the setting must be chosen to suit. Some properties or special costumes may be necessary—such details are often far from unimportant in an amateur film—if so do not leave their acquisition to chance, or wait till the last moment.

A Family Film

Even if you only plan an unpretentious family film with children in the leading parts, give the matter some thought in advance. Find a suitable location in the garden which is well lit and make notes on possible camera angles.

There is no need to plan every last detail; unrehearsed incidents are sure to occur, and the story will be the better for their inclusion. If, after shooting has started, a chance appears of getting an effective shot on another location, do not drag the shot in "by the ears"; work out some way of fitting it into the story.

It is not always possible to shoot every scene of even a simple story on one occasion. This need be no disadvantage; you can often take additional scenes at a later date and fit them into the footage already exposed. The important thing to watch when doing this is *continuity*. See that the children are wearing the same clothes and playing with the same toys, and that the action takes place on the same location. Then, provided the weather conditions are not too dissimilar, no member of the audience will notice that the sequence was shot at different times.

Holiday Films

Holiday films do not lend themselves to elaborate advance planning, but it is well worth studying guide books, maps and calendars of events in the locality to be visited, before setting out. Not only will this help to avoid disappointment; the research may well suggest a central theme which can be used to hold the film together—always a difficulty with such subjects.

Transitions and visual continuity links between sequences—dissolves, fades, etc.,—will appear more natural if they are planned in advance rather than improvised as shooting proceeds.

Written Records

For methodical work it is best not to carry all details of a film in your head. Make careful notes for each individual shot: action, costume, lighting, filter, lens and aperture, leaving space for a record of the result. A record of this kind enables the conditions at the time of shooting to be exactly reproduced when further shooting is required later. In the event of a technical fault, it also helps to establish the cause.

A record of footage exposed can be drawn up on the following lines, and be simplified or elaborated according to individual requirements.

SHOT LIST .... (date)

Shot No.	*Type (Distant, close etc.)*	*Scene*	*Light*	*Filter*	*Stop*	*Remarks*

Spontaneous Subjects

Films of events over which the movie-maker has no control, such as national festivals, sports meetings and so on, do not for obvious reasons lend themselves to detailed advance planning.

There it is important to show not only the action, but the people who are watching it, and how they react to it. This will convey to the audience something of the atmosphere of the occasion, whether grave or gay, friendly or hostile.

The first requirement is a good vantage point. If possible, the event should be filmed from several different camera stations. But if there is a danger of getting caught in a crowd when moving from one spot to the other, it is better to stay in one place. In that case, plenty of shots of the crowd, and of individuals, should be taken and cut in at suitable points at the editing stage. These *cut-away* shots will provide variety and help the continuity.

Choose a viewpoint also with due regard to the sun's position. The sun should not be directly behind the camera, or results—except with colour film—will be flat and lifeless. Nor should the light come from behind the subject. While concentrating on the action you may inadvertently aim the camera too close to the sun and ruin the shot. Always use an efficient lens-hood.

For a rapid change of lens the camera should preferably be fitted with a turret. If it is not possible to work from a tripod, the focal length of the lens used should not exceed 2 inches for 16 and 9.5 mm. cameras, and 1 inch in the 8 mm. gauge, for subjects with normal movement.

When filming fast-moving subjects such as horse-races, cars,

ski runs, etc. with the hand-held camera, focal lengths of up to 3 inches (16 and 9.5 mm.) and $1\frac{1}{2}$ inches (8 mm.) are permissible provided the camera is swung round so as to follow the main subject. The background will then be blurred, but this will enhance the impression of speed.

If the camera has a variable speed control, and you are prepared to use 50 per cent more film stock, subjects of this kind are best shot at 24 f.p.s., i.e. 50 per cent faster than normal silent speed. The results will be steadier on the screen.

Two final hints before setting out. Take a hold-all case; there are always accessories to be found or disposed of in a hurry. And make sure that your exposure meter is attached to your person by its neck-cord or waistcoat chain.

Filming Sports

The procedure suggested above for "newsreel" type films also applies to sports events. There is no need to work out an elaborate story in this case, as sports are usually interesting in themselves. Some sense of unity, or a thread of continuity running through, is of course desirable. We can for instance follow the progress of a particular golfer throughout the round, or trace the fortunes of one competitor in a tennis tournament.

To demonstrate the do's and don't's of a particular sport, it stands to reason that an expert should be consulted. But unless the film is intended for a specialized audience interested only in the finer points of the game, do not allow the sports professional to take charge of the film. The film director knows—or should know—best how to put the idea across to his audience.

Successful sports films are seldom made by a lone worker. A team of at least two or three cameramen is often needed to share the work and take up the best viewpoints. With events such as horse or motor racing, golf and cross-country running—in fact whenever the course is long, and/or start and finish are widely separated—team work of this kind is the only way to get adequate coverage.

When possible, sporting events should be filmed at 24 f.p.s.; this for two main reasons. Movement is reproduced more

smoothly; and it is easier to add sound, especially when wide distribution is aimed at.

Winter Sports

Winter sports are an obvious subject for the cine-camera. Newsreel technique (page 116) applies here too. As regards equipment, it is necessary to allow for the special conditions to be encountered.

The first thing, of course, is to ensure the safety of the camera. A case that is satisfactory at home may not afford sufficient protection in the Swiss Alps; and the way it is carried is important too. If slung over the back or shoulder it is likely to hit the ground first in the event of even a minor spill. It is better to hang the camera in front of the body, and tuck the straps under a belt to prevent bouncing.

The extremes of temperature met with in the mountains can play havoc with a cine camera. When a camera is very cold the oil in the mechanism may gum up and cause it to run slow.

Before taking an important exterior shot in very cold weather, always check whether the mechanism is running at the correct speed—if you know your camera well the pitch will usually tell you at once. If it runs slow, there is nothing for it but to warm it up. The best plan is to keep the camera inside outer clothing whenever it is not actually running; and this procedure will also minimize the other bugbear of cold weather filming—condensation on the lens produced by taking a cold camera into a warm room.

Apart from their optical qualities, filters fitted in front of the camera lens afford useful physical protection when snow is about. It is easier to clean a flat piece of glass than it is to get at the front element of a lens which may be recessed well inside the mount.

When shooting daylight-type colour film in snow, a haze filter helps to reduce the bluish over-all cast that is commonly encountered. The artificial light emulsion only requires the appropriate conversion filter for daylight; it also does duty as a haze filter.

Daylight is shorter in winter; so make the most of it. When there is snow on the ground it acts as an excellent reflector and you can afford to take risks with the light and shoot with the sun to the side of or behind the subject. But be sure to use an efficient lens-hood all the time.

Snow Subjects

Ski-jumping, slalom races and figure skating are natural subjects for ready made stories. Nursery slopes offer many amusing episodes. After filming some establishing long shots, take up a position near a bumpy part of the ski run where most beginners come to grief. Sooner or later someone will lose one ski on falling, and it will career away on its own leaving the owner helplessly poised on one foot.

The awkwardness of the beginners can be made to contrast with the assurance and poise of their instructor. Reverse action, obtained by inverting the camera (page 190) can make those who have come down the slopes with such effort, appear to return effortlessly to the top.

Ski-lifts and funiculars provide opportunities for tracking shots which should not be missed. It is also possible to film from a moving toboggan or, for an expert, on skis, but in both cases a fall must be reckoned with and the camera protected accordingly. Run the camera faster so as to smooth out the bumps.

While the tourists are out enjoying themselves, the villagers get on with the job. It is worth seeking out the craftsman at lathe, last or grindstone to contrast with the fun outdoors.

An extended ski tour is a tempting, but difficult, subject for a cine camera. The initial ascent is fairly easy to cover, as the other members of the party are moving slowly and the cameraman will have time to anticipate their course and compose his shots. When the summit is reached there will still be plenty of opportunities for planned shooting; but once the descent begins, it is every man for himself and the cameraman take the hindmost.

The only way to complete the film is to shoot material on several different occasions and finish the job on the editing bench, even at the expense of a few errors in continuity.

Settings and Atmosphere

The setting can play an important part in evoking the right mood for a film, or for a sequence within a film. The audience is influenced quite as much by the surroundings in which the action takes place, as by the action itself. So cheerful or humorous action should be filmed in a setting that fits the mood.

Lighting is also an important element in the creation of the appropriate atmosphere. Visual analogies: objects of the same shape; patterns of similar or contrasting movement, are another effective weapon in the movie-maker's armoury.

The titles, incidentally, are also part of the atmosphere. Good titles are as important to a film as is good typography in book-production. Their wording and layout require much more thought and time than the layman would ever imagine. Often it is desirable to superimpose titles on special backgrounds, or on characteristic action from the film itself.

Permission to Film

Documentary and story films are often shot in public places. In some parks and other public places in British towns permission has to be specially obtained before a camera can be used on a tripod—and a tripod is desirable whenever possible.

Permission is also required for museums, railway stations and theatres. In theatres and circuses permission may be refused, as not only may the noise disturb the audience, but making the film may constitute an infringement of copyright.

Copyright may also be involved when filming any published written or pictorial material—e.g. book pages, paintings, photographs. The publisher or artist should be approached, and permission is normally readily granted.

Amateur Actors

Apart altogether from the technical side of movie-making, a story film poses two main problems for the amateur. The first is to find an original story and write the screen treatment; the

second, to find amateur actors who are capable of giving a convincing portrayal of the characters.

Very few amateurs are able to act the part of someone quite unlike their real selves. It is therefore best to tackle the matter the other way round, and instead of trying to make actors portray the characters chosen to fit the story, write the story so that it fits the known characteristics of available actors. In this way, the actors will be called upon to do things with which they are familiar.

While the main parts can be tailor-made for the people who will play them, minor parts can sometimes be taken straight from real life. If the cast list includes for instance a postman, or shop-assistant, then enlist the services of an actual postman or shop-assistant to make the scene look really authentic.

Do not be in too much of a hurry at the shooting stage. The first thing to do is to ensure that the cast know what the story is about, and what is expected of them. This seemingly obvious point is stressed because film-making is necessarily a piecemeal business. The individual shots of a story are not necessarily filmed in the order in which they will ultimately be screened. This means that actors will be called upon to act isolated parts of the story out of context. To obtain convincing results requires clear knowledge of this context.

Not only may different shots in a given sequence be filmed on different occasions; where interiors are involved they will also probably require different lighting set-ups.

You must face the fact that films always take an inordinate amount of time to rehearse and shoot, and probably as much again to edit. And when it is all finished your masterpiece runs for just a few minutes on the screen. Professionals consider they have done a good day's work when they have produced 3 minutes of screen time for a feature film. Television films are made more quickly; but speed does not always make for quality.

Costume and Make-up

Costumes and accessories can greatly help to achieve realism in stories from contemporary life, while for period pieces they are essential. Many families can draw on the contents of old for-

gotten trunks in the attic; the services of theatrical costumiers are available to all.

Special make-up is not absolutely essential. For ladies ordinary town make-up, if really carefully applied, is adequate in most cases. The increasing popularity of colour film makes caution essential for those who are not experts in theatrical make-up.

In any event good make-up should look natural, not obvious —when directly examined. A simple application of foundation cream may be sufficient, and is recommended in any case for men, who should always shave carefully immediately before shooting begins.

For more elaborate make-up there is a standard procedure, given below in outline. The necessary materials are available from chemists and photographic dealers.

The skin must first be thoroughly cleaned with cleansing cream or astringent to remove all traces of grease, and wiped dry with cotton-wool.

Then apply foundation cream evenly over the whole face, not forgetting the roots of the hair, ears and nostrils, also neck and shoulders if these are exposed.

Next apply eye-shadow to the eyelids and rouge to the cheeks, using the tips of the fingers in each case and taking care that the colouring of the cheek blends with the basic character of the general make-up.

The eyebrows are then made up with a special pencil, using a tint as close as possible to that of the natural colouring. Apply lipstick or lip-paint with a brush to bring out the shape of the lips, bearing in mind that thick lips are more photogenic than thin ones.

An impression of relief can be obtained by using a lighter shade of rouge on the centre of the lower lip.

After completing the above procedure, apply powder liberally, removing the excess with the make-up brush. Then brush the eyelashes and in the case of women apply a little mascara.

To give eyelids and lips an extra sparkle they should be lightly smeared with vaseline. Brilliantine will do the same for the hair.

Special Make-up Effects

To make a person appear old and decrepit the face should be lightly greased; to create an effect of dirt it can be smeared with a mixture of lamp-black and powder. Foundation cream should be avoided as it produces a uniform surface. Natural wrinkles can be emphasized by pencilling in shadows. The mouth can be made to droop by accentuating the lower corners.

Eyebrows can be made to look bushy by false hair stuck on with an alcohol base varnish. The same procedure will produce a beard and a moustache. When building up a false beard, start at the chin and work towards the temples, finishing off with the scissors.

To make hair appear grey, apply grease, then powder liberally. In this case false hair or a wig is difficult to apply naturally, as the camera inevitably reveals where the real and the false meet, unless the services of a professional make-up artist are available.

The best way to check the effect of make-up is from a still photograph, exposed on film of the same type as that to be used in the cine camera. For colour, miniature 35 mm. film is ideal as the reversal emulsions used by several manufacturers of both still and sub-standard motion-picture stock are identical.

Make-up can be removed with pure vaseline, followed by a good wash in soap and water.

Treatments and Scripts

We now come to a few examples of actual film treatments and scripts. The first one, a documentary, is shown in master sequences; this is the form in which the film should be conceived in the first stage. The sequences are then worked out in somewhat more detail.

The second example is a shooting script of a story film. There the preparation has gone a step farther to map out the precise way in which each shot is to be photographed.

A STEAMER TRIP

Sequence I

As the mooring ropes are cast off, our boat swings round and moves away from the quayside. Friends ashore wave good-bye. But soon all details are lost in the distance and we can distinguish nothing but the rhythmic pitching of the masts of a craft at anchor in the port we have left behind.

Sequence 2

Escorted by seagulls overhead, we move towards a rocky mass which emerges from a horizon blurred in distant haze. Gradually our island destination becomes distinct.

Sequence 3

The breakers can now be discerned casting patterns of foam on the rocks of our island. Pine trees bend to the prevailing wind.

Sequence 4

The soft colours of the seascape are set off against the white of a tall lighthouse and landing-stage, where some idlers are watching our arrival. On the beach fishermen are laying out their nets to dry. Every sun-tanned face bears witness to an arduous calling. In the distance boys in gay sweaters are fishing with improvised tackle, intent upon the motionless float on their lines. A fishing boat passes slowly by, and its white sail is hoisted against the blue of the sky.

Sequence 5

On land now, we climb a sand dune, and as we reach the top the whole panorama of the island unfolds before us. The low houses nestling in folds in the terrain are surrounded by a profusion of flowers, contrasting with the poverty of the dwellings and the grey of the stone.

Sequence 6

An artist has set up his easel in a sandy path leading through a pinewood. With rapid strokes his brush recreates the colours of the seascape.

Sequence 7

At the edge of the heath stands a wayside shrine. The intricate open-work in the granite forms a striking contrast with the severity of the natural surroundings.

Sequence 8

A short way away, the view shows a humble cemetery. An old woman is on her way to tend the graves, and as she walks the scarf on her head flaps in the wind.

Sequence 9

Once more the seagulls wheel overhead. We are afloat again, and the camera is shooting downwards on to the ship's wake, which spreads out fanwise astern. The sun is low in the sky and the sea is full of dancing points of light.

This, then, is the more detailed treatment with notes on handling the sequences. It is just one step short of an actual shooting script.

Sequence 1

A medium close shot of ropes being coiled on deck is followed by a long shot as the pier moves away. If possible, shoot the departure of the boat as seen from ashore on another occasion; these two shots will lend variety and realism to the scene. Another way of starting is to use the ship's hull to make a *natural subject wipe* (page 185). As the boat is about to cast off shoot straight at the hull from close in and hold the shot until the vessel moves away and uncovers the view.

Sequence 2

For the seagulls use a medium shot. To make the birds stand out against the sky when shooting in black-and-white, use a yellow filter. Do not film the horizon without including some foreground feature—there are plenty of suitable objects on board. With colour film use a haze filter.

Sequence 3

A long shot of the coast as the ship moves nearer (tracking) will be effective, but do not aim the camera at right angles to the subject; choose your position so that the subject appears to approach or recede from the camera.

Sequence 4

A succession of long shots and close shots to establish the scene and focus attention on the fishermen at work. It is best to film the fishermen without their knowledge, using for example a right-angle viewfinder. Find some suitable foreground to lend depth to the long shots, and look out for colour contrasts.

Sequence 5

This consists largely of long and medium shots. Use a tripod when panning. Try to include people doing something to provide movement. Some close-ups of flowers will add interest.

Sequence 6

The artist's canvas fills the screen in a close shot to start with, then the camera pans slowly away on to his subject. Use an upward vertical panning shot to take in the painter's head above his easel. Take a big close-up of the palette, and of the brushes at work. (All the foregoing must of course be planned with the prior consent of the painter himself.)

Sequences 7 and 8

A long shot and a medium close shot introduce the sequence. Include plenty of sky in the frame; move the camera slowly. Take close shots of gorse bushes waving in the wind, and come in still closer for a shot of the old woman's scarf.

Sequence 9

The wheeling seagulls will provide an easy transition from the preceding shot of the flapping scarf. For the final long shot against the light use an efficient lens-hood. If in doubt as to the correct aperture, shoot the scene in duplicate at different settings.

A story film is rather more ambitious and introduces a few tricks such as animation (see page 203). This is a family film which can be made at home. If necessary, shooting can be spread over the winter months. There is no need to worry about the weather, as Photofloods will cover all needs.

CAGE BIRD

Cast: A young child (boy or girl) and its mother
Scene: The nursery

Shot No.	*Description*	*Scene and Action*	*Technical details*
1	C.U.	A pair of small legs swinging aimlessly to and fro under an armchair. Slow pan up to sulky child's face.	Fade in the start. Vertical pan later.
2	L.S.	A cheerful nursery.	Wide-angle lens or attachment.
3–6	C.U.	The furniture and toys, emphasizing immobility.	Rapid succession of brief shots.
7	M.C.S.	The child in the chair still registering boredom—looks towards the window.	
8	M.C.S.	The window curtains wave aimlessly in the breeze.	
9	B.C.U.	A determined little hand suddenly grabs the curtain.	
10	B.C.U.	A nose flattens itself against the window pane and two inquiring eyes gaze into space.	Shoot from a balcony or from ground level.
11	L.S.	Animated street scene: cars, pedestrians, a group of children.	Shoot downwards from an upstairs window.
12	B.C.U.	The child reacts in pleasure to what it sees.	
13	M.S.	Children organize a game on the pavement.	Telephoto lens.

Shot No.	Description	Scene and Action	Technical details
14	M.C.S.	To get a better view the child draws up a chair and stands on it.	
15	L.S.	The children playing excitedly.	
16	C.U.	The child in the window watching.	
17	L.S.	The children outside suddenly tire of the game and run off elsewhere, leaving the street empty.	
18	M.S.	The curtain falls to and the little face clouds over again.	
19	C.U.	A toy puppy seated on a cushion turns his head and waggles his ears. He obviously wants to be petted.	Animation, shooting frame by frame.
20	C.U.	But master (or mistress) remains unmoved.	
21	C.U.	A jointed doll suddenly stands up and walks with giant steps towards a gramophone.	Animation.
22	M.S.	The child watches, fascinated.	
23	C.U.	A record places itself on the turntable as if by magic, and the pick-up swings into position.	Stop motion: trick effect obtained by stopping and re-starting camera.
24	B.C.U.	The doll, with a great show of effort, winds the gramophone motor.	Animation.
25	B.C.U.	The label of the record—e.g. suitable nursery rhyme for boy or girl. Then the record starts to revolve.	
26	C.U.	The child hums the tune. Camera comes in closer until the image is out of focus and indistinct.	Tracking shot.
27–30	M.S.	Action from the song, as imagined by the child—e.g. Humpty Dumpty falling, Polly putting kettle on.	Rapid succession of brief shots.
31	B.C.U.	The gramophone stops and the record disappears.	Stop motion.
32	C.U.	The child reacts in disappointment.	
33	B.C.U.	The doll waves cheerfully to the child and climbs up the bookcase.	Animation.
34	C.U.	He takes out a large picture book and opens it.	
35	B.C.U.	The pages turn, then the book remains open at an illustration of a forest with wild animals.	
36–39	C.U.	Live animals in a zoo. In the corner of a cage an exotic bird crouches in boredom.	Make all animals appear to be at liberty by avoiding bars, people, etc. Only bird obviously in captivity.

Shot No.	Description	Scene and Action	Technical details
40	B.C.U.	Repeat shot 35. The cover of the book masks the illustration from view as the volume is closed.	Dissolve from 40 to 41, or arrange for the closing book and opening door to move in opposite directions.
41	M.S.	Mother opens the nursery door and holds out the child's coat.	
42	B.C.U.	The child's delighted reaction.	
43	L.S.	Mother and child walk through the gates into the park.	
44	M.C.S.	The child stops and looks upwards towards a tree.	
45	C.U.	A bird seated on a branch sings to his heart's content.	Telephoto. Fade out at end.

If you are shooting in colour use daylight emulsion and take all the interior shots in which the window is in the frame, in sunny weather. Then finish the reel on exteriors. For all the other shots load with artificial light emulsion, exclude all daylight and make sure that the window does not appear in the picture otherwise an unpleasant blue cast will appear.

If you have a zoom lens (page 140) it can be used to advantage for the shots in which the camera has to move, or appear to do so, e.g. shot No. 26.

Exposing single frames for the animated shots is a laborious business, and to save time the picture book can be so placed that the pages can be turned without the hands appearing in the picture. A black thread can be used to propel the doll up the bookcase and move the arms. Another means of simplifying the animation is to show only the upper half of its body, which can then be directly manipulated from below by an assistant.

In a sketch of this kind there is plenty of scope for imagination. Thus in the final shot of the bird singing cheerfully, it is not essential to film a real bird.

Finer Points of Equipment

We have already come across many of the main camera features as well as several of the refinements that increase the efficiency and versatility of advanced cameras. Here we propose now to examine in more detail the mechanical and optical aspects of the camera as a precision instrument.

The Intermittent Film Transport

Mechanically, the transport system is the heart of the cine camera. Its most important component is a claw. This moves in a regular cycle to engage the film perforation, pull the film down through the gate by one frame, disengage the perforation, and return to its first position for the next cycle.

The movement of the claw is continuous, but changes direction four times in each cycle. The resultant movement of the film is intermittent. Each frame thus remains in the gate for about half the period of the cycle and the shutter shuts off the light from the film during the remaining half.

In its simplest form a single claw engages one perforation along one edge (or the centre in the case of 9.5 mm.) of the film. This is also the only practicable type of claw for single-eight cameras.

Precision double-eight and 16 mm. cameras may have a double claw, engaging two adjacent film perforations simultaneously. This decreases the risk of the film jamming or other breakdowns due to a damaged perforation.

Alternative film transport systems also exist; the best-known is the Maltese Cross movement as used in 35 mm. professional

motion picture cameras. This is found only in the most expensive 16 mm. models.

The claw movement is also connected to the sprocket wheel which pulls the film off the feed spool (or from the feed chamber), and to the take-up spindle which winds up the film. The movement of the sprocket is, however, smooth. A loop of film between the sprocket and the claw mechanism prevents the intermittent movement from giving rise to strains in the film and avoids consequent damage.

The whole transport movement is operated by a spring-driven clockwork motor. When fully wound, the motor usually runs for appreciably longer than the duration of an average shot. Nevertheless it is advisable to rewind the motor after every take, to avoid getting stuck in the middle of a shot. On cheaper cameras the motor speed also drops as the spring runs down; with better models an automatic governor stops the motor as soon as it loses speed.

Variable Speeds

While the normal speed for taking and projecting silent films is 16 frames per second, it is sometimes an advantage to vary the running speed of the camera. Some cameras have provision for this. A typical range of speeds is 8, 16, 24, 32, 48, and possibly 64 f.p.s. Intermediate settings are usually possible.

When the camera is run faster than normal, e.g. at 32 or 48 f.p.s., action appears slowed down when the film is projected at the normal speed; the "slow motion" effect is a familiar and valuable feature of sports films, enabling technique to be studied in detail at leisure.

Conversely, if the camera is set to run slower than normal, e.g. at 8 or 12 f.p.s., action appears speeded up on the screen. Street traffic, or an inexpert swimmer, can be made to move at speed and raise a laugh.

It stands to reason that the faster the *camera* runs, the more rapidly film is used up; though if the *projection* speed remains constant, a given length of film will run for the same time on the screen.

The standard speed for recording and reproducing 16 mm.

sound films is 24 frames per second. If you are using this gauge and intend to add an optical or magnetic sound track (page 260), use a camera that can run at this speed. Although film with a magnetic track or stripe can be projected at 16 f.p.s., the sound quality is better at 24 f.p.s.

A speed of 24 f.p.s. is also useful to obtain greater image steadiness in outdoor shots, especially when panning the camera but also for shots taken from a moving vehicle.

The shutter speed increases with the camera speed (i.e. the exposure time is reduced and this must be allowed for in setting the aperture), but is not necessarily the same with every camera. Variations are generally due to slightly different sector angles of the shutter. An average at 16 f.p.s. is about 1/32 or 1/35 second.

EXPOSURE TIMES AT DIFFERENT CAMERA SPEEDS
Fixed sector shutter of 180 degrees

	Camera speed (f.p.s.)						
	8	16	24	32	48	64	128
Exposure time (seconds)	1/15	1/35	1/50	1/60	1/90	1/125	1/250
Aperture adjustment compared with 16 f.p.s.	1 stop smaller	None	½ stop larger	1 stop larger	1½ stops larger	2 stops larger	3 stops larger

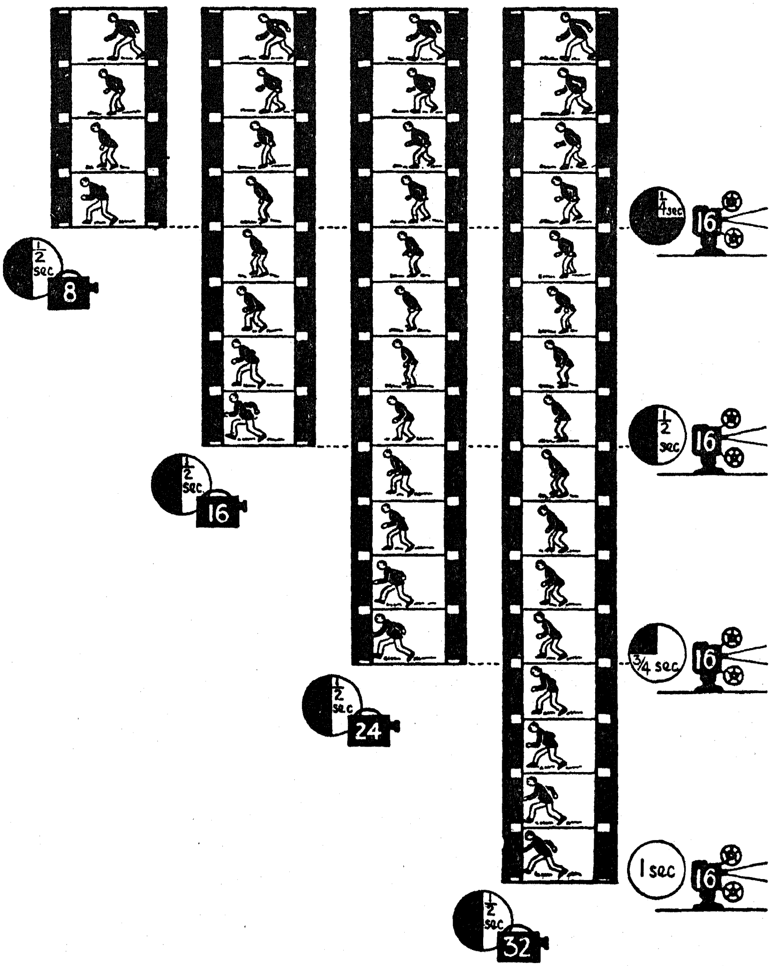
The exposure time can be reduced by a variable sector shutter (page 138) even at slow camera speeds.

Checking Camera Running Speed

It is sometimes desirable to verify the actual running speed of the camera, especially when making a sound film and when the exact timing of subject movement is important. There are two alternative methods.

1. Load the camera with a length of discarded film. Choose a fixed reference point in the mechanism, such as the gate aperture or one of the sprockets, and make a mark on the film at this point. Then run the mechanism for 5 seconds, measuring the time by a stop-watch. Mark the frame now opposite the same reference point, unload, and count the number of

THE EFFECT OF FILMING SPEED



The amount of film exposed in the camera during a given period depends on the running speed. Some cameras can be set to run at 8, 16 (normal silent speed), 24 (normal speed for 16 mm. sound film) or 32 frames per second. The amount of film exposed during $\frac{1}{2}$ second at these speeds is illustrated above. If the same action is filmed at different camera speeds, it will be depicted in different lengths of film. But the film is normally projected at the same speed of 16 frames per second. With a low camera speed action is therefore speeded up, while with a high camera speed it is slowed down on the screen. Altering the camera speed also affects the exposure. When running at half normal speed, close the lens aperture by one stop (e.g. from *f* 8 to *f* 11); at double normal speed, open up the aperture by the same amount (e.g. from *f* 8 to *f* 5.6).

frames (or perforation holes) between the marks. If the camera is running correctly at 16 f.p.s., the number of frames should be $16 \times 5 = 80$, equivalent to 2 feet of 16 mm. or 9.5 mm. film (1 ft. of 8 mm.) To allow for errors of timing in the camera and stop-watch, make several tests in succession and take the average.

If the camera has a frame counter (page 137), there is no need to mark the film.

2. Set up the camera opposite a clock fitted with a clearly visible second hand, load with fresh film and run the camera for several seconds. When the film comes back from processing, examine the individual frames in a viewer or by projection. The number of frames exposed per second can be directly observed in the photographic image.

If no suitable clock is available, it may be possible to place a pocket watch in position on a titler so that the second hand is visible, and film it there.

Back Winding

Advanced spool-loading cameras have provision for cranking the film in reverse by means of a special handle. The lens must be covered while this is done, to protect the film from accidental exposure, and a second exposure can then be superimposed on the first, in order to produce a dissolve (page 182) or superimposition (page 195).

With some cameras it is possible to disengage the motor and wind any desired length of film back on to the feed spool. But when the motor cannot be disengaged nor the film be taken up on the feed spool, back-winding is limited to 1 or 2 feet at most. This is only sufficient for a brief dissolve or super imposition. Any attempt to wind back further in such cases will cause the mechanism to jam, and may easily strain or break the spring.

When planning back-winding on a camera of this type, the spring should not be wound up to more than approximately half tension.

For dissolves and superimpositions of professional quality, an individual frame counter is almost essential. In its absence,

the frames can be counted by noting the number of turns of the back-winding crank handle (each turn usually moves the film eight frames forwards or backwards), and/or by exposing one frame at a time.

This use of back-winding must not be confused with the technique used to obtain *reverse motion* on the screen (page 190). That is done by holding the camera upside down when shooting a scene, ~~then inverting~~ the strip of film so exposed when splicing into the rest of the film.

Electric Motors

For the ordinary short shots—which the majority of movie makers are concerned with—a spring motor serves the purpose perfectly well. Rewinding the spring is a matter of a few seconds and the camera is immediately ready for the next take.

For more advanced work, especially for the professional, the continuous drive of an electric motor is, however, a great asset. Its particular uses are in newsreel and documentary filming, industrial and medical picture making, as well as in time-and-motion studies, etc. In all these cases the cameraman can start filming and carry on for the full length of the film in the camera without being limited by the capacity of a spring.

A built-in electric motor is usually found only on professional 16 mm. cameras. A number of advanced models with clockwork motor can, however, also be adapted by fitting an accessory motor to drive the camera through the manual transport shaft (as used for back winding). The exact method of fitting depends on the camera. As the motor adds to the weight, the camera should always be used on a tripod.

The power supply may be the electric mains (sometimes through a step-down transformer), or batteries. The latter make the cameraman independent of location and permit maximum freedom of movement.

One or two 8 mm. amateur cameras are also available with a small built in electric motor, driven by a $4\frac{1}{2}$ volt torch battery. One battery is usually sufficient for several double-eight spools. This arrangement is only possible owing to the

light weight of the 8 mm. spool and has not proved adaptable to the larger gauges.

The Starting Button

The camera motor is usually set in motion by depressing the starting button. Often it is possible to operate the camera by means of a cable release. The cable attaches to a socket in, or surrounding, the button, or directly to a socket on the camera body. Occasionally an adapter is required to fit the cable to the starter button.

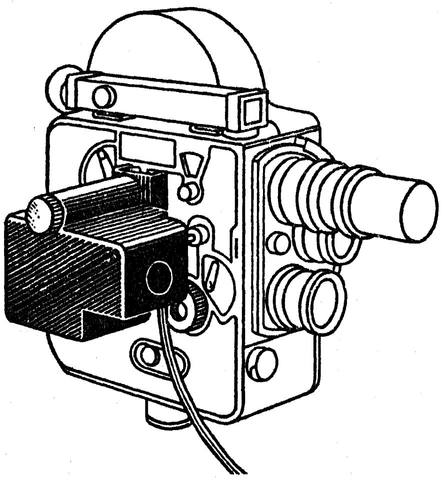
The cable release can also be combined with a pistol grip, and several models are available where the plunger of the cable is mounted on the grip itself. Alternatively the trigger of the pistol grip may, by a suitable linking arm, bear directly on the starter button of the camera.

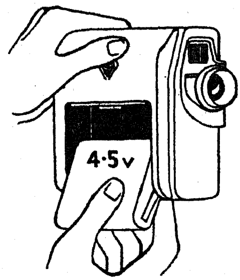
While the cable release permits operation of the camera from even several feet away, even more distant operation is possible with an electric release—a relay powered by torch batteries. This is useful for subjects such as birds, wild life, and other nature subjects.

In addition to normal operation by depressing the starting button, many cameras provide a continuous running lock. This keeps the motor running until it runs down, and leaves the cameraman free to appear in his own shot, or to operate other controls (change the distance setting, adjust the setting of a zoom lens, close down the diaphragm for a fade-out, etc.) during a take.

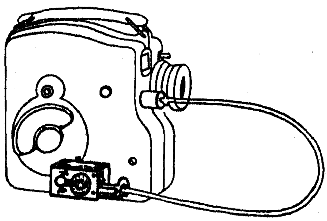
In practice the camera must of course be mounted on a tripod. The cameraman then depresses and locks the starter button (after fully winding the motor), rushes to join the scene, and at the end hurries back to the camera to stop the take.

With a self-timer it is even possible to avoid the loss of film at the beginning and end. In that case wind the motor (after it has fully run down) only sufficiently to expose a given length of film. This must be found by experiment. Then attach the self-timer to the cable release, set it going, and join in the scene. After the appropriate amount of film has been exposed, the camera stops of its own accord.



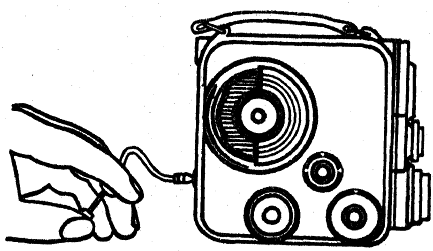


Electric motor drive makes it possible to expose a whole reel if desired without stopping to rewind. Some professional type 16 mm. cameras (*left*) can be fitted with an electric motor as an accessory. The batteries in this case form a separate unit. One model of 8 mm. camera (*right*) has a built-in electric motor powered by a standard 4.5 volt flashlight battery. In everyday filming the average shot is not usually held for more than 10–20 seconds—indeed it should not last longer or the result may be tedious—and clockwork mechanism is quite adequate. But occasions arise, especially in sports and industrial work, when the need to stop shooting in order to rewind a clockwork motor may mean the loss of an important shot. This is when the electric motor comes into its own.



The cameraman can appear in his own films from the beginning of the shot by fitting a delayed-action device to the cable-release of his camera. The procedure is to compose the shot, leaving a vacant place for the cameraman in the picture area; set the camera; start the delayed action device; and join in the action.

To avoid camera-shake when exposing single frames it is desirable to use a cable release. The same applies in normal filming when the camera is placed on a flat surface but not screwed in position, and whenever very accurate framing of near-by static subjects is required.



Single Frame Exposures

Almost all cameras are able to expose single frames. In some models there is a special setting of the speed control at which the camera exposes one frame only. In others (most simpler ones) it is necessary to press the starting button sufficiently briefly so that the motor does not run on beyond one frame. That usually requires a little practice with the camera concerned.

When set for single frame operation, the instantaneous exposure will be longer than when running continuously owing to the inertia of the mechanism. The normal exposure in single frame operations is about 1/20 second when the speed control is adjusted to 16 frames per second. If the camera is set for a speed below 16 f.p.s. the single frame exposure will also be slower; but it remains at 1/20 second on all the faster speed settings.

We have already seen that movement can be adequately reproduced by recording isolated phases of it in a camera and running the film in a projector. If therefore a camera is designed to expose single frames, it can be used to animate a wide variety of object such as toys, maps and drawings. The camera is placed on a firm stand, and the position of the object or shape of the drawing is altered very slightly between each exposure. When the film is projected, the object or drawing appears to come to life (page 203).

Titles can also be filmed in this manner (page 174), while a further use is in stop-motion (page 189).

Time Exposures

When a scene is too poorly lit to be filmed in the normal way, it is possible on some cameras to take a series of time exposures on individual frames. Typical examples are: sunsets, urban scenes at night, buildings and monuments under floodlighting, nocturnal seaport scenes.

First decide the number of seconds the scene is to run on the screen, multiply by the number of frames per second, and the product will be the required number of time exposures. If

the camera is not designed to take individual time exposures, it may be possible by using the back wind handle to locate the position where the shutter is open and make the exposure by moving the handle.

To obtain uniform exposure from frame to frame, it is best to stop well down, as any variations are then less marked.

Another way of obtaining uniform exposure is to leave the camera shutter open, place a still camera shutter fitted with slow speeds in front of the camera lens and expose by means of this shutter.

Footage and Frame Counters

All cameras are fitted with an indicator showing the amount of film exposed, or remaining unexposed. The accuracy varies with the type of camera; the counter is usually calibrated in feet or metres, though on some simpler models the markings indicate the amount exposed by a series of fractions, e.g. 1/4—1/2—3/4.

The simplest type of indicator is actuated by a lever that bears on the coil of film on either the feed or the take-up spool. As the spool empties or fills, the arm actuates a pointer or disc indicating the passage of the film through the mechanism. The readings given by this system are only approximate, but it has the advantages of requiring no resetting when the camera is loaded, and of clearly indicating when the camera is empty.

The commonest type of indicator is geared directly to the mechanism, with provision for automatic return to zero when the spool chamber or the gate is opened. On high-grade cameras the passage of film can be read down to the nearest foot, or 25 cm. on metrically calibrated models.

Professional type cameras fitted with back-winding mechanism (page 132) usually also have an individual frame counter which, like the footage indicator, operates both forward and in reverse. A typical frame counter will read up to 2,000 (50 feet of 16 mm. film) before returning to zero. Some cameras may also give an audible signal at regular intervals, enabling the operator to measure the footage while observing the scene.

Variable Sector Shutters

Normally, the camera shutter is a semi-circular disc which covers the film aperture during transport and uncovers it for the exposure. Instead of a simple disc it is also possible to use two sectors with a variable angle between them, enabling the exposure time to be varied independently of the speed.

Some professional-type 16 mm. cameras (and even one amateur 8 mm. model) are fitted with such a variable sector shutter which can be adjusted (by means of a lever or knob) while the camera is actually running. This feature is an advantage for producing special effects such as fades and dissolves (page 178) in the camera. To obtain a proper fade with a fixed shutter, the lens aperture has to be moved over a range of at least four stops, and this is not always possible. But by opening or closing a variable shutter any scene can be faded in or out, independently of the aperture setting.

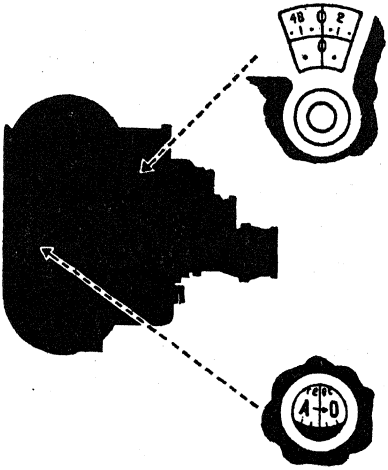
Another advantage of the variable shutter is the opportunity it provides for selecting the most suitable combinations of shutter speed and lens aperture for the subject, as is commonly done in still photography. If greater depth of field (page 27) is required, the shutter can be opened, enabling the lens aperture to be closed, and vice versa.

With fast moving subjects, a smoother effect on the screen is obtained with shutter fairly wide open (though individual frames are more blurred). If sharp definition is required on the film, the shutter sector should be reduced, but the result on projection will be a more "staccato" movement.

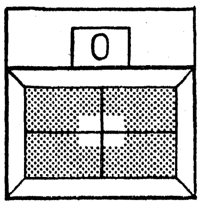
Thus at 16 f.p.s. the exposure time with the shutter fully open at 180 degrees might be 1/30 second. With the shutter half closed at 90 degrees the effective exposure time would then be 1/60 second, three-quarters closed (at 45 degrees) it would be 1/120 second.

Lens Mounts

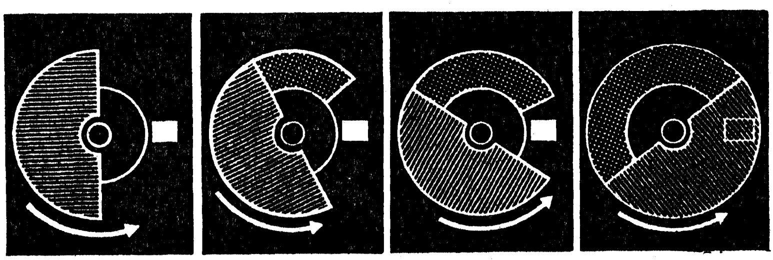
Lenses are normally fitted with a threaded mount. For 8 mm. cameras the standard mount is known as type D. It has a 5/8 inch (15.8 mm.) thread and 32 turns per inch, and the



Professional type 16 mm. cameras have separate counters calibrated in feet (or metres) and individual frames. When the film is wound backwards, both counters operate in reverse, enabling special effects involving double exposure such as superimpositions and dissolves to be made over a pre-determined footage of film. The frame counter (*above left*) is set manually and in the model shown here reads up to 2,000 (equals 50 ft. of film). The footage counter (*below left*) operates automatically as long as the spool chamber door remains closed, and returns to zero when the door is opened.



Left: One camera has a footage counter which can be read off in the finder while actually filming. The optically adjustable finder of another model has a similar window indicating the focal length of camera lens to which it is matched.



Above: Some advanced 16 mm. cameras—and one 8 mm. model—are fitted with a variable sector shutter. *Left:* 180 degree shutter in the fully open position. As the shutter is progressively closed, the period during which the aperture remains uncovered, and thus the exposure of the film, is reduced, until in the fully closed position (*right*) no exposure takes place. Fades can be made by opening and closing the shutter while filming. Depth of field can be altered at will by selecting a suitable combination of shutter speed and aperture, as in still photography. A sharper image of rapidly moving subjects is obtained by using a narrow shutter sector.

setting (clearance between lens rear flange and film plane) is 0.484 inch (12.29 mm.).

The standard mount for 9.5 mm. and 16 mm. cameras is the type C, with a 1 inch (25.4 mm.) thread and a setting of 17.52 mm. Some lenses have a different thread and/or setting, or a special bayonet or spigot mount for rapid attachment and removal.

Adapters are available to enable lenses fitted with type C mount, designed for 9.5 and 16 mm. cameras, to be used on 8 mm. cameras with type D mount. The converse is not possible, as lenses designed for 8 mm. cameras have insufficient covering power for the larger gauges.

Cameras with type C or D lens mounts will thus accept a wide variety of lenses, enabling the user to embrace a larger or smaller field of view at will (page 26).

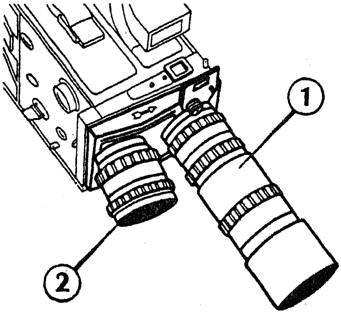
Several lens manufacturers produce wide-angle and telephoto attachments which screw into the front of the standard lens. Though the optical design is different, the effect is the same as when using a separate wide-angle or telephoto lens. These attachments are valuable when the design of the camera precludes the use of interchangeable lenses—e.g. when exposure meter or rangefinder are built in.

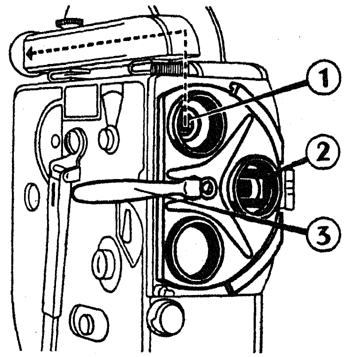
Lens Turrets

Some advanced cameras are fitted with revolving or sliding turrets accommodating either two or three lenses. They greatly facilitate a rapid change of lens. Some turret models incorporate or are mechanically coupled to matched finder lens elements which automatically ensure that taking lens and finder cover the same field of view (see page 26).

The Zoom Lens

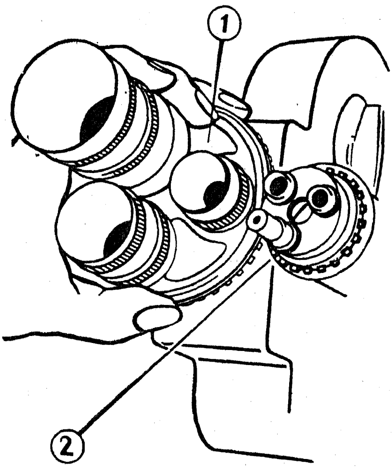
Two French firms manufacture lenses with continuously variable focal length for 16 mm. cameras. There is also one model for 8 mm. cameras. An adjusting lever moves two of the lens elements relative to the others, and can be operated while the camera is running. The cameraman can thus pass from a

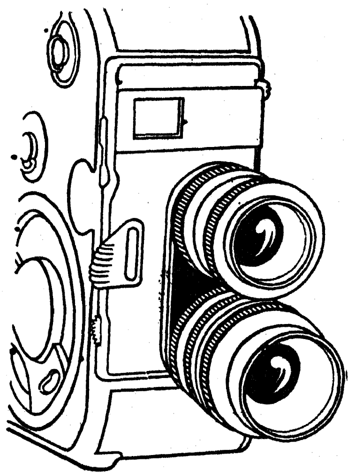




Lens turrets are fitted to advanced cameras in both 8 mm. and 16 mm. gauges, to facilitate rapid change of focal length. *Left:* Twin turret with offset lenses on professional type 16 mm. camera. The mounts are angled so that a long-focus lens (1) does not encroach on the field of view of a wide angle lens (2). Lenses on this camera also carry matched finder lens elements which automatically register with the eyepiece.

Right: Triple turret camera incorporating reflex focusing finder (1). The picture aperture is at (2). For accurate focusing the turret is turned anti-clockwise by the handle (3) to bring the taking lens into position (1). This model is available for both 8 mm. and 16 mm. film; in a special version the optical path of the finder extends to the picture aperture through a prism system for through-the-lens focusing even during shooting.





Left: Triple lens turret (1) geared to matching finder turret (2). The operator always sees the field of view corresponding to the lens in use. *Right:* Twin pivoting turret on advanced 8 mm. camera. The finder on this model has an independent control.

wide-angle to a "telephoto" effect or vice versa, at will. The result is similar to that obtained by moving the camera bodily towards or away from the subject, hence the expression "zoom". The effective aperture remains the same irrespective of the focal length setting.

This lens can also be used to ascertain the best focal length setting for a given subject, before shooting begins. When used in this way, the adjusting lever is then left unaltered on the selected setting. The finder image is automatically adjusted to the field of view corresponding to the focal length setting. Focusing, however, has to be set by scale.

The model for 8 mm. cameras has a type D mount and a focal length range of 12.5 to 36 mm. (½ to 1½ inches). The maximum aperture is *f*2.8, and the focusing range is 2½ feet to infinity. Parallax correction is automatically provided throughout the focusing range.

The latest type of zoom lens for 16 mm. cameras fitted with type C mount has a reflex finder, thus obviating the need for parallax correction between finder and taking lens. It is available in two models: the focal length ranges are respectively 17.5 to 70 mm. and 25 to 100 mm.

The reflex finder is detachable, being held by a captive threaded collar.

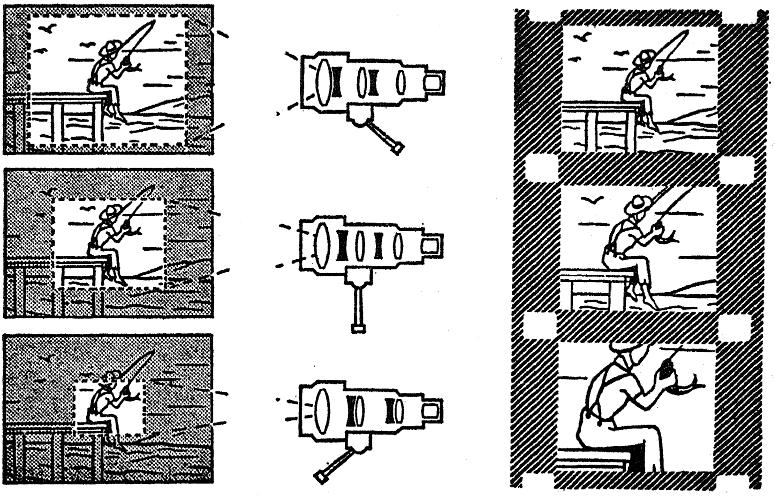
When a zoom lens is used on a camera already incorporating a reflex finder, the finder on the lens itself becomes becomes superfluous.

A zoom lens should not be regarded as a substitute for a battery of conventional lenses of different focal lengths. Sharpest definition will always be obtained with lenses of fixed focal length.

Depth of Field Scales

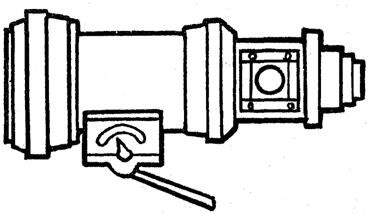
Many modern lenses have a depth of field scale engraved on the lens mount. The *f*-numbers of the aperture scale are duplicated on each side of the index mark on the focusing scale, and indicate extent of depth of field for any combination of aperture and distance setting.

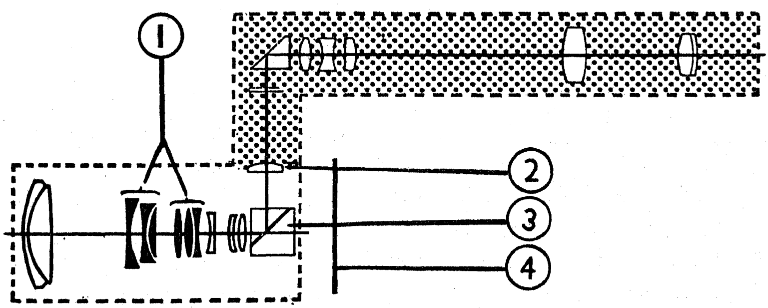
After focusing the lens, read off the nearest and furthest



The variable focal length of the zoom lens allows the operator to produce tracking effects towards the subject without moving the camera. Focal length is altered by moving the lever which extends from the lens barrel. With the lever in its rearmost position (to the right in the diagram above) the lens embraces a wide field of view. As it is moved forward (to the left) the field narrows, and distant objects appear enlarged on the film.

Below and right: Adjustment of focal length in a zoom lens is effected by moving certain lens elements (1) relative to the others. The latest type of zoom lens are fitted with a reflex finder. The viewfinder field lens (2) receives an image reflected by a small silvered spot in the prism (3). The main image is formed on the focal plane (4).





points of sharp focus, which will be found opposite the figures corresponding to the lens aperture in use. Some indicators use a system of bracket-shaped lines, or appearing and disappearing red dots, but the principle is the same in all cases.

Lens Coating

Most modern lenses are provided with a special anti-reflex coating on the glasses, to increase light transmission, and to eliminate scattering and reflection of light at air-glass surfaces. This ensures more brilliant images and greater lens speed.

Lenses treated in this fashion appear bluish or purple when examined by reflected light.

Scale Orientation

Screw-type lens mounts are usually fitted with an adjustment enabling the focusing and aperture scales to be orientated for easy reference when the lens is screwed fully home and opposite the gate. Adjustment may be carried out by means of grub screws, or a spring-loaded internal spline.

Fixed Apertures

Some cameras are fitted with a perforated revolving aperture plate instead of an iris diaphragm. Holes of graduated size are stamped in this plate and brought into register with the lens as desired. Intermediate settings are impossible, and of course, the aperture plate cannot be used to make fades.

Focusing at Near Distances

It is sometimes desired to film at very close distances. A fixed focus camera lens does not normally give a sharp image of objects closer than about 5 feet, while the near focusing range of lenses fitted in focusing mounts is not always sufficient for titling and copying purposes.

The extent to which very close objects are rendered sharply is of course governed by the depth of field (page 27), and this

is reduced as the lens diaphragm is opened up. There are two alternative methods which enable a lens to be focused on very near subjects: the use of a supplementary lens in front of the main lens; or of an extension tube between lens and camera.

Supplementary Lenses

Positive (i.e. magnifying) supplementary lenses are available from photographic dealers in various powers, usually suitable for filming at 40, 20, and 10 inches from the subject. The power of these lenses is expressed in diopters, the diopter being the reciprocal of the focal length in metres.

When placed immediately in front of a camera lens that is focussed on infinity, a supplementary lens brings objects situated at its focal length into sharp focus at the film plane. Thus a 1 diopter lens is of 1 metre focal length, giving sharp definition at about 40 inches; 2 diopters = ½ metre = sharp definition at 20 inches, and so on. They can be fixed to the front of the lens with adhesive tape or inserted into filter holders. The hollow face (if any) should be as near as possible to the camera lens and on the same plane and on the same axis. Ordinary positive spectacle lenses can also be used with a cine camera, though as they are not optically corrected it may be necessary to use a small aperture to avoid poor definition.

As fixed focus lenses on cine cameras are usually focused on a distance between 4 and 20 feet, care should be taken when using supplementary lenses not specifically designed for the lens on the camera to allow for this fact. This is because the plane of sharp focus with the supplementary in position is thereby brought closer.

The distance of sharp focus can be found by multiplying the distance on which the camera lens is actually focused by the focal length of the supplementary lens, then dividing the result by the sum of these two distances. The following example will make the calculation clear:

Fixed focus lens on 8 mm. camera.
Focal length 12.7 mm. (approx. ½ inch).
Actually focused sharply at 127 cm. (4 feet 2 inches) (= 100 times the focal length).

1.5 diopter spectacle lens, focal length 66.67 cm. or 26¼ inches.

To ascertain plane of actual focus:

$$\frac{127 \times 66.67}{127 + 66.67} = 43.73 \text{ cm. or } 17\tfrac{1}{4} \text{ inches.}$$

All figures must, of course, be expressed in the same denomination—here it is centimetres.

The use of a supplementary lens does not, of itself, call for any adjustment of the lens aperture, as the *f*-number of the lens combination remains unaltered.

Extension Rings and Tubes

An alternative method of sharply focusing very close objects is to increase the distance between the lens and the film plane. This of course is what happens when a focusing lens is adjusted for close distances, but the movement does not usually permit focusing nearer than 1½ feet. On some cameras it is possible to render the stop on the lens focusing inoperative and bring closer objects into focus.

Otherwise the lens is removed from its mount and an extension piece inserted between the two.

The near limit of focusing will then be around 12 inches with a ring 0.5 mm. thick on an 8 mm. lens camera with ½ inch lens, or about 8 inches with a 1 mm. ring. On a 16 mm. camera the limit with a 1 mm. ring would be about 13–15 inches with the standard 1 inch lens.

If a ring or washer is used, the thickness is of course limited by the length of the screw thread available on the lens. In any case, handling of the camera is awkward at extremely close distances, and proper illumination of the subject becomes difficult.

Accurate centring of the subject is already tricky at distances of about 18 inches, and it is still more critical when the camera is brought in even closer. Unless the camera is fitted with a reflex finder, it will be necessary to open the camera and check the image in the gate.

In cinemicrography, where subject areas are measured not in inches, as with the extension rings mentioned above, but in fractions of an inch or millimetres, longer lens extensions are obtained by means of tubes fitted with a reflex finder device. The lens is screwed in one end and the camera in the other. Different degrees of enlargement are obtained by the use of a set of tubes of varying length.

When filming with extra lens extension it is necessary to increase the exposure (i.e. usually open up the lens aperture) when the scale of reproduction is larger than 1:10. The amount of extra exposure is ascertained by reckoning the *f*-number of the lens as the nominal *f*-number multiplied by the scale of reproduction + 1. For instance, when an object is reproduced at half size on the film, the *f*-number required is multiplied by $1\frac{1}{2}$, i.e. *f*4 becomes *f*6, and the lens must be opened up by one stop. Similarly, at actual size *f*4 becomes effectively $4 \times (1 + 1) =$ *f*8, and the lens must be opened by 2 stops to regain a working aperture of *f*4.

At very close distances the depth of field is also extremely restricted, and plenty of light will be required to enable the lens to be stopped down for adequate sharpness.

Finders

Most cameras are fitted with an optical viewfinder showing the subject area covered by the standard lens at a reduced scale.

When the camera is designed to accept interchangeable lenses or lens attachments there is usually some provision for adapting the field of view of the finder to that of lenses of different focal length, especially telephoto lenses (page 26). On simpler cameras this is achieved with masks, or by one or more rectangles engraved on the front glass of the finder to indicate a narrower field of view.

More elaborate cameras have an optically adjustable finder, providing an image that fills the full finder area for all focal lengths within the range of the device.

When using a wide-angle camera lens, it may be necessary to fit a special supplementary lens on the front of the finder to match the field of view of the lens.

Some turret model cameras are fitted with individual finders, each matched to its respective lens and automatically brought into position when the corresponding lens is in the taking position.

Before using a telephoto lens for the first time on a camera fitted with a finder mask or engraved rectangle, it is advisable to check the finder alignment. Film a test shot of a clearly defined object that just fills the frame, with the camera mounted on a tripod, and see how far the image on the film corresponds with that seen in the finder. If the camera gate is accessible, it may be possible to check the alignment by observing the gate image and comparing it with that in the finder.

Parallax Correction

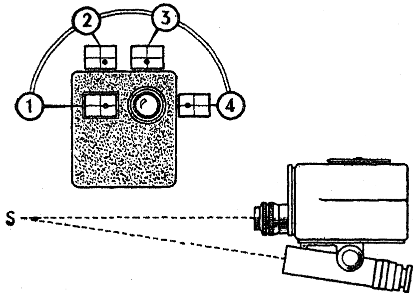
The parallax error of the finder (page 32) at close distances has to be compensated by estimation on cheap cameras. On more advanced cameras various ways of parallax correction provide accurate framing of close shots.

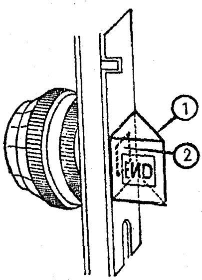
A common feature on cameras with finder located above the lens is a special mask, or dotted line on the finder front lens, indicating that at close distances the subject must be kept below that level by tilting the camera upwards.

On higher priced instruments the finder eyepiece can be moved relative to the camera body, to enable the cameraman to view the exact scene recorded by the camera lens, though from an oblique angle. For certain fixed distances some camera finders can be fitted with special parallax correction prisms, which achieve the same effect.

Viewing through the Gate

For the serious worker, the only way to avoid parallax entirely at closer distances is to view the image through the actual taking lens, exactly as it is recorded on the film. Several advanced cameras can be fitted with a special gate focuser for this purpose. This device consists of a small ground glass screen that is placed in position in the gate, a mirror or prism, and a magnifier. The camera has to be unloaded when the focuser



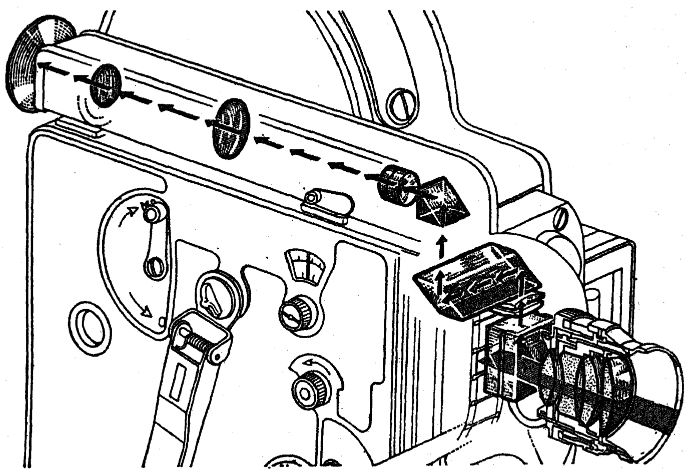


Above left: The camera finder and the taking lens see the view from different positions. At close distances this so-called parallax error can result in serious mistakes in subject framing. The position of the finder varies according to the make of camera. Some finders have a mark for sighting close subjects. The subject is first framed normally, then the camera is moved until the centre of the observed image coincides with the dot on the finder front glass. According to the finder position, the subject should be centred on the dot at 1, 2, 3, or 4.

Above centre: Some finders have mechanical parallax adjustment, and can be swung over so that fields of view match.

Above right: At very close distances the image should be checked in the camera gate, by removing the pressure plate and placing a prism (1) in position over the aperture (2).

Below: Parallax error is eliminated on cameras with reflex focusing. On this model the finder image is reflected along the path shown, by a prism located between the taking lens and the gate.



is inserted. In the case of spool-loading cameras this means that the focuser can only be used before loading (or the reel must be wound back if this is possible). With magazine loading cameras for which a gate focuser is available, this drawback does not apply.

Reflex Finders

Some professional-type cameras incorporate a finder which enables the gate image to be viewed while the camera is loaded, and in some cases also during the actual shooting. The advantages of this arrangement, which of course gives parallax-free viewing irrespective of the lens in use, and also when using close-up attachments or extension tubes, need no stressing.

One type of reflex finder, giving an image only when the camera is at rest, consists of a small movable prism located in front of the gate which reflects an image to the finder, and is automatically moved out of the way by the action of starting the mechanism.

Other reflex finders give a continuous image, visible also while the camera is running. The finder image is either obtained by reflection from a thin sheet of glass placed in front of the gate so as to divert a small portion of the light rays; or the front surface of the shutter blade is silvered so as to reflect the image along the finder path each time it passes in front of the picture aperture.

A continuous reflex finder enables not only composition, but focusing and lens aperture to be adjusted during the actual filming.

Some turret cameras, though not fitted with reflex through-the-gate focusing, are fitted with a separate focusing aperture where a lens can be adjusted visually, then swung into the taking position.

The aperture contains a prism with one side ground to act as a focusing screen and in some cases a supplementary prismatic finder enables the image to be viewed from behind the camera. This arrangement is an aid to focusing and composition, but a parallax error still remains, as the lens is not in the taking position when the device is in use.

SUMMARY OF SPECIAL CAMERA FEATURES

Feature	*Advantages*
Magazine loading	Easy and rapid loading. Ability to change partly exposed films without winding back.
Spool loading	Maximum footage (in 16 mm.). Special effects possible when camera fitted with back-winding mechanism.
Focusing lens	Maximum definition; no supplementary lenses needed for close-ups; improved perspective rendering.
Interchangeable lens	Ability to fit telephoto lens for distant subjects, and wide-angle lens for confined spaces. Extreme close-ups possible with extension tubes.
Two- or three-lens turret	Instantaneous change of lens, particularly valuable for newsreel and holiday shots.
Optically adjustable finder	Accurately indicates field of view of different lenses. Facilitates composition.
Finder with parallax adjustment	Accurate framing for close-ups and titles.
Visual end-of-film indicator	Prevents loss of shots through inadvertent use of empty camera.
Aperture scale visible in finder	Enables aperture to be adjusted during shooting, e.g. in panoramic shots. Facilitates fading-in, as you can see when to stop opening the iris.
Aperture control lever	Very handy for making a fade out; can even be used with hand-held camera.
Eye-level focuser	Accurate visual check on focusing and (with some cameras) field of view.
Gate focuser	Dead accurate image centering, ease of focusing, shows exact field of view of any lens.
Reflex finder	Same advantages as for gate focuser; operates with loaded camera and (in some cases) during shooting.
Right-angle finder	Very valuable for informal and action shots, as people can be filmed unawares.
Variable speeds	Ability to reproduce motion faster or slower than normal. In very weak light underexposure may be avoided by running camera at its slowest speed.
Single frame operation	Animation of toys, drawings and other objects. Time-lapse shooting for serious study or humorous "speeded up" effect.
Back-winding crank	Indispensable for dissolves and superimposition.
Frame counter	Facilitates special effects; operates both forward and in reverse, enabling film to be wound back an exact number of frames.
Built-in coupled exposure meter	Simplifies correct aperture setting, which can be adjusted while shooting.
Variable-sector shutter	Fades possible without altering lens aperture. Gives control over depth of field.
Rangefinder coupled to lens	Visual focusing possible both before and during shooting.
Electric motor	Duration of shots limited only by length of film. Remote control possible.

The Rack-over Compensator

An additional accessory known as a rack-over parallax compensator is available for some cameras for use in conjunction with the eye-level focuser. It is fitted between the camera and its tripod, and serves to displace the camera in such a way as to bring the gate into exactly the position previously occupied by the focusing aperture. The subject can thus be both focused and centred accurately in the eye-level focuser.

Right-angle Viewfinders

When people are unaware of the camera, a more natural result is often obtained. A right-angle viewfinder, which enables the cameraman to face away from his subject while yet aiming the camera in the desired direction, can be of great assistance. It is available as an accessory for some advanced cameras.

When using an angular viewfinder it is particularly important to ensure that the camera is held dead level; when cameraman and camera are facing in different directions, a conscious effort may be needed to hold the camera straight.

Camera Accessories

A wide variety of camera accessories is available to supplement built-in features or to extend the scope of the camera.

Some accessories are available for all models, and can be regarded as essentials. They include a camera case (either to hold the camera only, or to accommodate accessories as well—in a so-called *hold-all* case), an exposure meter, a lens hood, and a tripod (preferably with a pan-and-tilt head).

Filters and supplementary lenses are also available for most cameras, but are required only for specific purposes. Other accessories, like a cable release, pistol grip and a rangefinder for near distances, are equally useful on occasions.

The Lens Hood

Most cine lenses are recessed to a certain extent inside their mounts, which forms a lens hood. But for best results it is ad-

visable to fit an additional lens hood to guard against the influence of stray light.

Shots taken without a lens hood often appear grey and over-exposed. When the sun's rays strike the lens either directly or by reflection from a shiny surface, a patch of light like a small moon may appear in the middle of the picture.

Lens hoods are available with screw-in or slip-on mount. The former is preferable, as there is no risk of the hood falling off. Filters and lens hoods are often available with identical screw threads, which facilitates working with both accessories at once.

Bellows-type lens hoods, which can be adjusted according to the focal length of the lens in use, are available for some professional type cameras, and are the most efficient of all. As they are bulky, the camera has to be mounted on a tripod.

Avoiding Cut-off

When using a lens hood that is not specially designed for the particular lens, or focal length, involved it is necessary to ensure that it does not encroach on the picture area. This can be done by exposing a few feet of film on a subject of uniform density, e.g. clear sky, at a lens aperture of $f5.6$ or $f8$. When the shot is projected, the picture area should show no variation of density towards the edges.

Coupled Exposure Meters

As the use of an exposure meter is so important in filming—especially in colour—certain advanced cameras in both 8 mm. and 16 mm. gauges are fitted with a built-in photo-electric exposure meter. This is directly coupled to the iris diaphragm, and the meter needle is visible in the finder. There is provision for setting the mechanism according to the speed of the film in use and the running speed.

Adjustment of the control lever so that the needle remains in the central position, automatically provides the correct aperture. It is thus possible to alter the aperture during shooting in the event of a change in subject brightness.

One type of 16 mm. camera is fitted with an automatic aperture control, in which the meter itself actuates the iris diaphragm through an electric motor, driven by a small dry battery. Alternatively, the driving motor itself may adjust the iris according to the meter reading, as soon as the camera starts to run. There is provision for overriding the mechanism.

An alternative system incorporates an interchangeable camera lens and an exposure meter in one unit. This can be fitted to cameras that do not already have a built-in exposure meter, and is used in the same way as a built-in meter.

Looking After the Camera

The most important item in camera maintenance is absolute cleanliness. Refer to the instruction book for details of any special precautions that may be necessary.

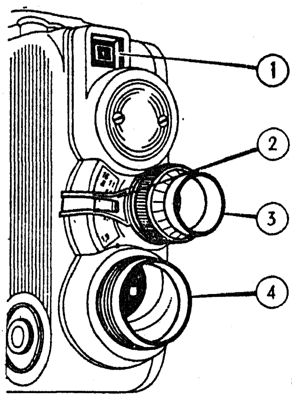
To clean the camera, start by unscrewing the lens or, if it is not removable, cover it with a cap. Then open the spool or magazine chamber and remove all dust with a camel-hair brush and watchmaker's bellows.

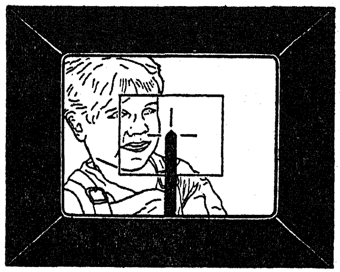
To inspect the gate, the pressure plate is swung or pressed open (the procedure varies with different models). Emulsion particles are sometimes found adhering firmly to the corners of the gate or in the film channel. These obstruct the free running of the film and may scratch it. Remove them with a match or orange stick wrapped in a fluffless piece of cloth, which can be moistened if needed. On no account use a metal object. The film aperture must be kept absolutely clean, using the brush and bellows; any foreign body may not only scratch the film but also appear greatly magnified on the screen. After cleaning the film channel, close the gate.

Avoid running the camera at a high speed (i.e. above 48 f.p.s.) without a film in it.

Camera Lubrication and Servicing

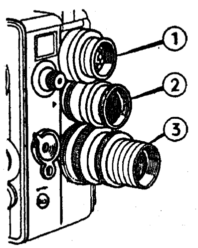
As a general rule it is seldom necessary to oil a camera. When new, the lubrication supplied at the factory is sufficient for several years' normal use, and if further attention is required,

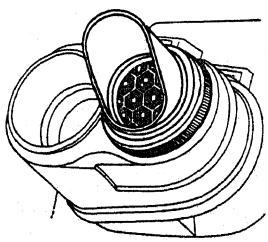


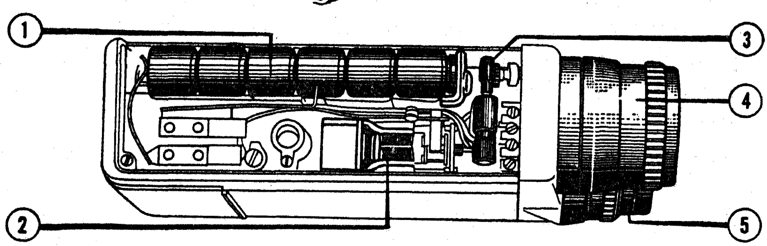


With an exposure meter coupled to the lens iris the operator can adjust the aperture while actually filming. On some models (*above*) a pointer is visible in the finder (1), which reacts according to subject brightness and is kept central by moving the aperture lever (2). This adjusts the iris of the taking lens (3). The intensity of the light is measured by the photo-electric cell (4) which controls the pointer.

Right. Two-lens 8 mm. camera with bulit -in exposure meter. Lenses and photo-electric cell are mounted on a sliding turret. 1. Cell. 2. Standard ½ inch lens. 3. 1½ inch telephoto lens. To bring the telephoto lens into operation the sliding turret is moved upwards. *Far right:* with some cameras the meter is coupled to the interchangeable lens and is removable with the lens.







Above. 16 mm. camera with fully automatic aperture control. 1. Batteries. 2. Aperture control motor. 3. Worm drive to lens iris. 4. Film speed setting ring. 5. Lens. With this model the operator aims the camera at the subject, and the photo-electric cell automatically sets the aperture according to the available light. If light is insufficient, a warning signal appears in the finder. With many cameras having a built-in meter, an adjustment of the aperture control allows for operation at various running speeds and with different film emulsions. Some 8 mm. cameras are available with automatic iris control operating without batteries.

the fact is usually noted in the instruction book. In an emergency, when the mechanism appears to run unevenly and the camera cannot conveniently be returned to the manufacturer, you can place a single drop of fine machine oil on each exposed bearing, wiping the excess away carefully afterwards. For this purpose, a modern oiler, designed to deliver a small measured quantity of oil, is very useful. Such gadgets are made in the form of a hypodermic syringe, or of a fountain pen.

Never dismantle your camera; to do so will invalidate the manufacturer's guarantee. Furthermore you may disturb the light-trapping in the process, resulting in fogged films, the cause of which may remain undiscovered for some time.

Whenever any repair or adjustment appears necessary, it is always best to consult a photo dealer or the manufacturer.

When the camera is stored away, allow the motor to run down completely, then give the winding key one full turn.

Do not leave a partly exposed film in the camera for long periods. It may become brittle and jam the mechanism next time the camera is started. Image quality suffers from prolonged storage too, especially with colour emulsions.

The Care of Lenses

The lens is a delicate piece of precision optical equipment, and should be treated accordingly.

Whenever it is not in use, keep the front protected with a metal or rubber cap. As a reminder against filming with the cap in position, you can stick a piece of cardboard or plastic to the lens cap in such a way that it protrudes and obscures the finder.

The external glass surfaces only should be cleaned from time to time—but on no account dismantle the lens elements to get at the inside. Cleaning procedure differs according to whether the lens is provided with anti-reflection coating or not. On no account should any lens surface be touched with the bare fingers.

For an uncoated lens use special lens-cleaning tissue, or a fluffless cloth moistened with a few drops of methylated spirit or carbon tetrachloride.

If the lens is coated on external surfaces, no liquids or cloth should touch the lens surfaces. To remove dust, use a fine camel-hair brush or watchmaker's bellows.

Where the lens is coated on internal surfaces only, the exterior surfaces can be cleaned with a fluffless cloth moistened with a few drops of distilled water.

Lens Defects—Apparent and Real

Small air bubbles are frequently present in lenses. They have no measurable effect on lens performance, and indeed with modern types of optical glass it is in practice impossible to avoid the formation of such bubbles.

But if the surface of a lens appears scratched, it should be returned to the manufacturer for re-polishing. If any marks in the form of fine lines with a matt appearance are present, they indicate that the cement holding the elements together is defective. In this case also, the lens should be returned to the maker.

The metal surfaces inside the mount, both in front and behind the lens elements, are always painted dead black to avoid internal reflections which would seriously degrade the image. It is most important to ensure that the enamel does not wear off, leaving a bare metal surface. This can happen without the knowledge of the owner, and cause a deterioration in image quality that may be hard to trace.

Titles

NO FILM IS COMPLETE without at least a *main* and an *end* title. The audience needs to know the subject, and where and under what circumstances the film was shot.

Even with a sound film the action is sometimes not entirely clear without explanatory *sub-titles.*

When a film is made by a team of people it is a matter of common courtesy to give their names in the form of *credit* titles at the beginning or end.

Without a Titler

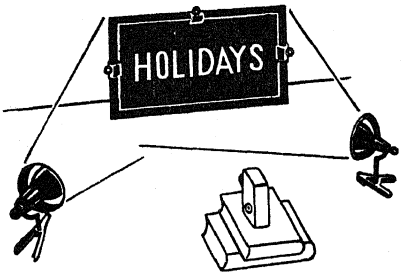
It is perfectly possible to make titles without a proper titler.

Correct alignment of the camera is always the greatest problem, and with rough and ready arrangements this cannot be set once and for all. One solution to the problem of alignment is to write the titles in a deliberately haphazard manner or diagonally across the titling area.

In an emergency, you can mount the camera on a tall tripod and point it vertically downwards towards the ground. Alternatively place it on a table tripod and write or pin the titles on a vertical drawing board placed in front of it.

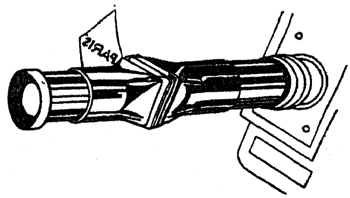
Artificial light is more reliable than daylight and two lamps in reflectors are required, one on each side of the title and directed obliquely across it.

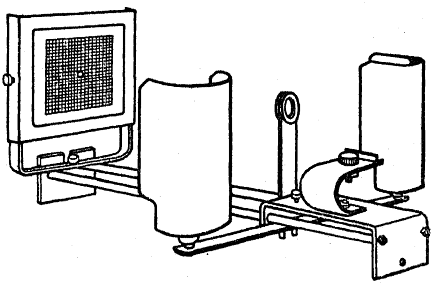
There is no need for special title letters every time, either. If you are filming on holiday or at a sporting event, there will usually be signposts and other notices available which can be included in the film to tell their own story. When introducing a new locality, try setting up the camera to start on a close shot



Left: A titler can be improvised by placing the camera on a pile of books, standing a title card up in front, and lighting it with two lamps in reflectors. Accurate alignment and uniform lighting are important, but difficult to obtain if the units are not fixed in position.

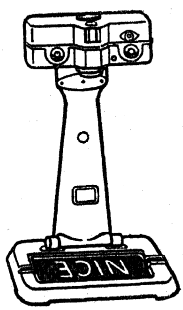
Right: Device for superimposing titles on live action, using 2 × 2 in. slides. The title is written on translucent material, mounted and placed in the slide carrier. The action is then focused on the slide by adjusting the lens on the extreme left, and the attachment placed in front of the camera lens, which records the action and superimposed title.

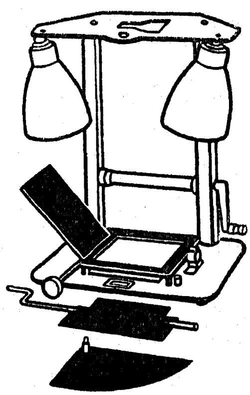




Left: Horizontal titler. This consists of a title board with centering grid, lamps in reflectors, a lens centering template, and a camera clamp. When buying a titler make sure that there is a sufficient adjustment range in the camera platform to bring your camera into accurate alignment, and that the adjustment, once made, can be maintained. Test exposures viewed by projection are the only reliable guide to calibration.

Vertical titlers have the advantage that the material to be filmed does not have to be fastened in position. These two models are for 8 mm. cameras; that on the left is designed for use with one particular make and is ready calibrated, incorporating register pins that fit into the camera base. The titler on the right incorporates accessories for flap-over, wipe and roll-up effects and its own lights. The camera platform (*top*) acts as a lens extension ring bringing the lens into focus on the titling area.





of the place name and pan to a long shot of the actual place.

Quite adequate titles can often be simply written up on the spot on walls, doors, shutters or a card. There is no need to be an expert lettering artist. If the film shows a child at play, let the child himself write his title in chalk.

Some of the special titling effects mentioned in this chapter are obtained more easily by reverse motion technique—involving an inverted camera or title—as described on page 190. The method is not really suitable for 8 mm. film, as it involves additional complications if the final screen image is not to appear laterally reversed.

Sand and Snow

Sand and snow are ideal surfaces for ready-made titles. In both cases the sun should strike the lettering at an oblique angle so as to throw it into relief.

On the beach you can get a child to rub the letters out with his spade when the audience has had time to read them; in the mountains a skier can rush past and do the same thing. In both cases this action can provide its own transition to the next scene.

If title letters are written in sand near the edge of the sea when the tide is coming in, they can be made to appear out of the sea by filming in reverse motion (page 190). The camera is run upside down as the tide washes the letters away.

Letters can also be written on a window pane covered with hoar-frost (see also page 202).

Choosing a Titler

There is a wide range of titlers on the market and some can provide very elaborate effects.

The two things to look for in a titler are: rigidity, especially in the camera cradle, and a method of centring the camera in relation to the title. It is also a great advantage if the titler can be used vertically as well as horizontally. With the camera positioned vertically above the baseboard, title letters and other objects can simply be laid in position.

As most titling is done with fairly large movable letters, it is important that the board or card should not be too small or the number of words that can be fitted in will be limited. Abbreviations are not really desirable in titles anyway.

There are also several miniature and even pocket titles on the market, especially for 8 mm. cameras. They clip on to the camera lens and take small title cards or transparencies. They are reasonably adequate for making simple titles (and for superimposing them on action) but not sufficiently versatile or accurate for serious work.

Selecting the Titling Distance

Most titlers provide a titling area of about 6 × 8 inches. Cameras fitted with standard lenses then have to be placed within 18 to 24 inches from the title, according to the focal length of the lens and the gauge of film.

There is, of course, no theoretical restriction on the size of titling area, which can be calculated by the following equation:

$$\text{Width of title card} = \frac{W\ (D - f)}{f}$$

In this equation W is the width of the *projector* gate (see below), D the titling distance measured from the film plane in the camera, and f the focal length of the *camera* lens.

Projector gates are always slightly smaller than camera gates; thus a slightly larger image is recorded in the camera than appears on the screen. It is therefore always advisable to test title alignment and centring by projection to avoid cutting off the edge of the title.

FRAME AND PROJECTOR GATE DIMENSIONS

Film Gauge	*Actual Frame Dimensions* mm.	*Projector Gate* mm.	in.
8 mm.	3.51 × 4.8	3.28 × 4.37	0.123 × 0.172
9.5 mm.	6.5 × 8.8	6.00 × 7.93	0.236 × 0.312
16 mm.	7.47 × 10.41	7.21 × 9.65	0.284 × 0.380

Lettering

White or coloured titling letters in various sizes are available in cork, felt, plastic and magnetic metal.

With a horizontal titler and vertical titling board, the letters must, of course, be stuck in position. Felt, plastic and magnetic letters are all supplied with special backgrounds to which they adhere. In the other cases, rubber solution can be used for the purpose. It is here that the advantage of a vertical titler with horizontal board is most evident.

The choice of fount of letters is a matter of personal preference. It is, however, most desirable to have a fount of both capitals and lower case. The cheaper sets of letters have capitals only, but long titles spelt out in capitals do not read well.

For layout purposes a pair of philatelist's tweezers, a ruler and a special layout card or squared paper are very useful.

Unless the purpose is to show an actual typewritten document, titles written on a typewriter are not satisfactory. The impression is not firm enough and the black letters on white are less suitable than the reverse. The same drawback applies to handwritten titles in black ink on a white background.

Title lettering can also be traced from magazines, or composed with the aid of one of the handy stencil outfits sold in office equipment shops. A warning, however, is necessary against tracing white letters on black background. Any corrections are immediately visible on the matt surface.

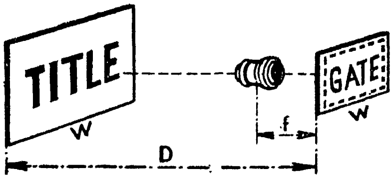
If you can vary the distance between camera and title, or have interchangeable lenses, a single fount of letters can serve many purposes. The size of the lettering on the screen can be varied for dramatic purposes. If an obstinate child is filmed when saying "I won't", his words might appear in a sub-title filmed very near (or with telephoto lens) so as to fill the screen.

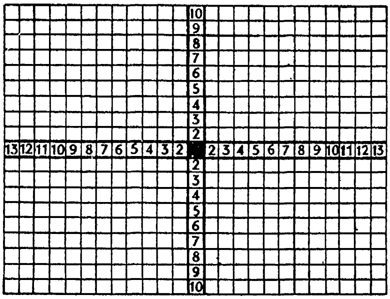
Camera Alignment

The camera must be properly aligned in the titler. Any error in centring the image is immediately apparent owing to the great degree of enlargement on projection.

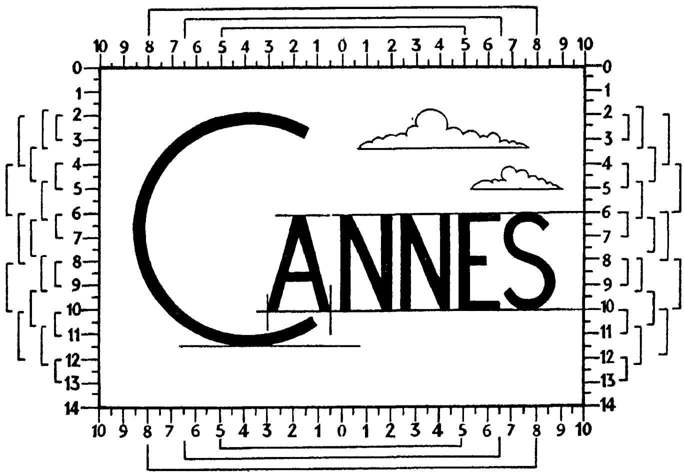
With a camera that permits reflex focusing, enabling the

The width of title card required depends on the focal length of the *camera* lens (f), the distance from title to focal plane (D) and the width of the *projector* gate. To find the width of a title card for any gauge of film, lens and filming distance see the table of film and gate dimensions on page 161.





Left: To calibrate your titler you can use a sheet of squared paper to fit your titling area and marked with reference numbers radiating from the centre. Expose about 3 ft. of film on this card, have it processed and join it up in a loop, and check the image by projection. You can then read off your exact titling area from numbers visible on the screen.



This alignment chart is numbered to facilitate accurate positioning of any size of lettering. The horizontal numbers start from the centre so that the same margin can be left on both sides. But upper and lower margins are more elastic, and subject to artistic considerations which are less easy to define. In this example the word "Cannes" has identical margins on each side, but the last five letters are placed well below the centre line of the card.

actual gate image to be observed, centring presents no problem. But remember that the projector aperture is slightly smaller both ways than the camera gate; so the screen will not show everything that the camera records.

Before starting to align the camera, be certain that it can be firmly clamped in position after adjustment, so that the setting is not lost when it is removed. Even when provided with parallax correction, camera finders are seldom accurate enough for title centring purposes.

Alignment should therefore in all cases be tested by filming a special card, covering the whole titling area with ruled squares over the whole surface. Squared drawing paper is very suitable for the purpose. Mark the centre square in black, then number each successive square in both directions horizontally and vertically until the edge is reached. Fix the card firmly in position on the board. Place the camera in position and check by removing it and replacing it so that the same squares are visible in the finder each time. Switch on the lights and expose two or three feet of film (for example, to finish off a reel).

When the film comes back from the laboratory, splice it together in a loop and run it continuously in the projector. You can then see the exact titling area by reading the numbers visible on the screen, and calibrate the board accordingly.

If, after this, you wish to align the camera by means of the finder, you can also mark out the area actually seen through it. As this will probably not correspond to the actual titling area owing to parallax, be careful not to confuse the two sets of markings.

Through the Gate

If the camera has a removable gate, the titling area can be ascertained by direct observation. Some cameras can be fitted with a special gate focuser (page 148). Where this is not available, a focuser can be made up from a piece of tracing paper or blank film with its surface roughened with sandpaper, and a triangular prism obtainable from an optician.

The piece of paper or film is placed in the gate aperture where the film normally runs, and the prism placed behind it.

The paper or film acts as a focusing screen and the prism turns the image through 90 degrees, for viewing from the side.

If the camera is fitted with a hand-crank, this can be turned until the shutter opens; the title image is then clearly visible. In the absence of a hand crank, lock the starting button in the "on" position, allow the motor to run down and then gently operate the winding key until the shutter opens.

An alternative method with cameras having an accessible gate is to hold a small torch bulb against the gate. Focus the camera lens on the appropriate titling distance, darken the room and project the image of the bulb on to a white card on the board. The exact limits of the filming area can then be marked out directly on the board.

With a precision-built titler in which the camera carriage moves towards and away from the copy board and maintains exact alignment, slide the camera forward so that the lens hood touches the board. Mark this point in pencil; it then indicates the centre of the titling area.

Focusing

With a focusing lens, proceed as for any close object, the distance being measured by tape *from the title to the film plane* (not the front of the lens) and the adjustment set accordingly.

With a fixed focus lens, a supplementary lens will be necessary (see page 145). The measurement is then taken *from title to supplementary lens*, and the distance will depend on the focal length of the supplementary lens and the distance on which the camera lens is actually focused.

Title Illumination

Two lamp holders in reflectors are required, one on each side of the board. The larger the titling area, the farther back the reflectors must be moved in order to equalize the illumination. Shield the lamps carefully, so as not to cast any light towards the camera. This should be fitted with a lens hood and particular care taken that the latter does not cause cut-off, as sometimes occurs at close distances.

Domestic opal bulbs of 40 to 100 watts are perfectly suitable for black-and-white film. The higher powered lamps enable the lens to be stopped down, which may be necessary when the letters and the background are in different planes.

When the lettering is required to stand out in strong relief, use a 100 or 250 watt spot lamp. A slide or motion picture projector can also be pressed into service; the latter should be run fast to ensure that its shutter frequency is out of phase with the camera shutter.

When using Photofloods (page 96) take care to avoid overheating. The lamps can be connected through a series-parallel switch (page 100) and used on half power during preparations for the shooting.

With glass, or other shiny backgrounds, make sure that there are no reflections of the lamps visible from the camera position. The reflection of the camera itself may also be seen on a glossy title background. This can be avoided by placing a black paper mask in front of the camera with a circular hole large enough for the lens.

As in all artificial light work, the exposure depends on the speed of the film, the power and distance of the lamps from the subject and the nature of the subject. A great deal also depends on the relative efficiency of the reflectors used.

Exposure for Black-and-White Titles

Most titles for black-and-white films have white lettering on a black backbround. Suggested exposures for such titles using medium speed (27°BS or 40 ASA) black-and-white film and two 100-watt pearl lamps in reflectors are:

Lamps at 8 inches from card: *f*5.6.

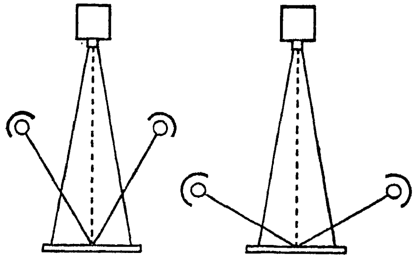
Lamps at 14 inches from card: *f*4.

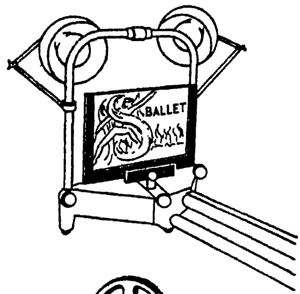
To minimize graininess with 8 mm. film, use slow, fine grain stock (22–25°BS or 12–25 ASA) and set the lens aperture to one stop larger in each case.

These figures are only a rough guide and should be used as a basis for experiment.

An exposure meter can also serve to determine the aperture for black-and-white titles. Place a light grey card on the title

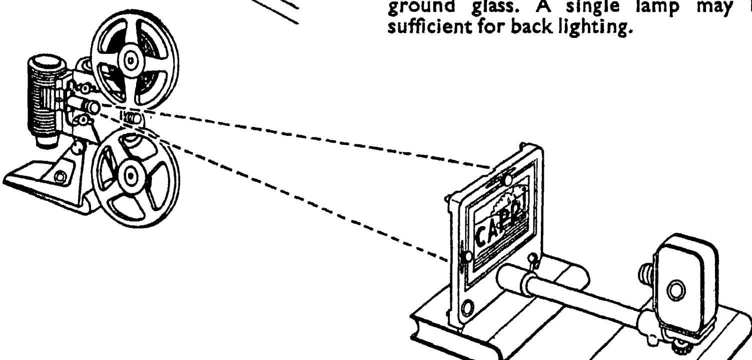
Right: For uniform illumination of titles, use two lamps in reflectors placed equidistant from the title card. To avoid reflections from the lamps, position them as on the *extreme right*, at an oblique angle to the title, and examine the title from the camera position.





Advanced titlers can be used to obtain silhouette effects by positioning the lamps so that they illuminate the title from behind.

The title is written on a sheet of ground glass or tracing paper. Familiar objects such as a spool of cine film, a leaf or a key can be placed behind the title and between it and the light, so that their shadow is projected on to the ground glass. A single lamp may be sufficient for back lighting.



Titles in black lettering can be superimposed on live action by back-projection. The title is written on translucent material and filmed against a background provided by the projector. When using 9.5 or 16 mm. film, it is laced up laterally reversed in the projector. The 8 mm. gauge can be reversed by projecting via a mirror. The most reliable working method is to advance the film one frame at a time in both projector and camera. If both instruments are run continuously at the same speed, there is the danger of black-out if the two shutters go out of phase. Exposure must be determined by trial and error.

board and take a reflected light reading. A direct reading from the title lettering itself will give gross over-exposure in this case; though it is quite suitable for titles with *coloured* backgrounds that are to be filmed on *colour* stock.

Titles in Colour

Coloured titles can be filmed on artificial light stock, using Photoflood lamps if a faithful colour rendering is required, or ordinary domestic bulbs if a much "warmer" result is acceptable. A spotlight can also be used, though here again the lower colour temperature (page 102) of the light will not give an exactly correct rendering of the original.

Use colour with moderation. The letters themselves should preferably be either white, pale blue, cream or some other light shade. The background should harmonize with the letters themselves.

Coloured titles must also match the shots they immediately follow and precede. For example, after a seascape in which blue will be the predominant colour, a title in brick-red tones would be quite out of place.

Title background colour can be uniform or patterned. In the latter case avoid symmetry. Textile surfaces offer wide scope.

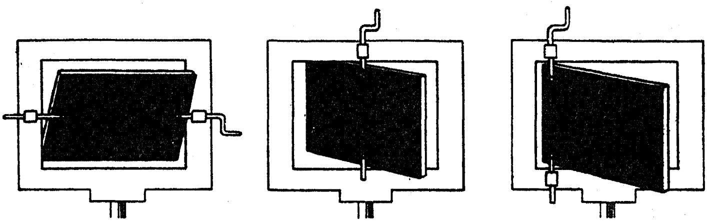
Any coloured picture, coloured postcard, water colour painting or illustration from a travel folder can provide a very good background, particularly when the place represented figures in the film itself. The white title letters are then laid on top so as to stand out clearly. As in the case with black-and-white titles, avoid fussy detail. The composition is best stylized with large areas of uniform colour.

Timing

Titles should remain on the screen long enough to be read comfortably by the audience for whom they are intended.

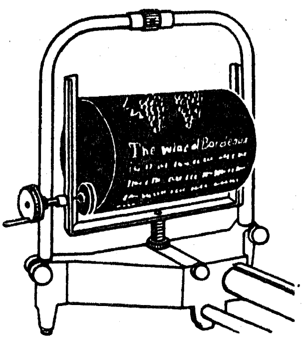
There are two important points to remember. Firstly, you already know the titles and can read them more quickly than the audience will be able to. Therefore, allow extra time when

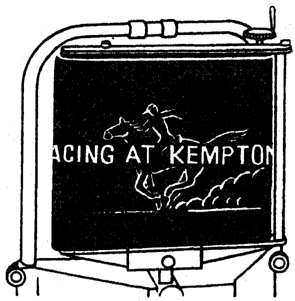
Titles can be wiped on and off with black card or cards moved in any desired direction. A platform for the cards is required between camera and titling area. When two cards are used single frame shooting is necessary. True title wipes call for double exposure using camera back-winding mechanism.

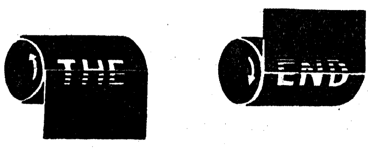


Above: Flap-over titles are made by composing two successive titles, or a diagram or photograph and title, on opposite sides of a pivoting card. The card is then turned over by the crank handle while the camera runs.

Below: Roll-up and file-past titles are composed on a drum or endless strip of paper, which is then wound on during the exposure. They enable longer texts to be used than conventional static titles.







Combining roll-up title with wipe card. For the first word a horizontal card is fixed along a pre-determined line so as to mask off the lower half of the frame. The word "THE" is then rolled *up* into view. The card is then re-positioned to mask off the upper part of the frame, and the second word rolled *down* into view.

filming. Secondly, children require longer to read titles and this should be allowed for with family films.

The main title of a film, even if it only consists of one word, should remain on the screen for at least 4 seconds. A one-line title can run for about 6 seconds, two lines need about 10 seconds.

A single word sub-title should not run for less than 2½ to 3 seconds unless there is a special reason for cutting in an interjection such as "Help!" in a fast dramatic sequence. Such a word might be flashed on the screen for as little as 1 second.

Longer sub-titles of fifteen to twenty words should remain on the screen for up to 12 seconds.

Running Titles

A long title can be written on a continuous band stretched between two rollers placed above and below or at the side of the titling area and operated by a crank handle. This device can also be used for a moving background.

A running title can also be composed on a drum which is rotated while the camera runs. A typical drum for 8 mm. titling has a diameter of 3¾ inches and is 5 inches wide, providing a vertical titling space of 8 inches, or more than twice the area of a normal static title card.

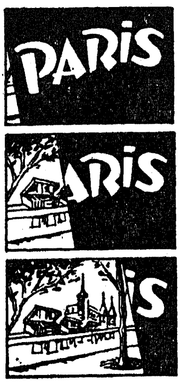
When filming roll-up titles, make sure that the lens aperture used provides sufficient depth of field. The centre line of the title may be as much as 2 inches closer to the camera than the top and bottom lines. This can make quite a difference when shooting at close range.

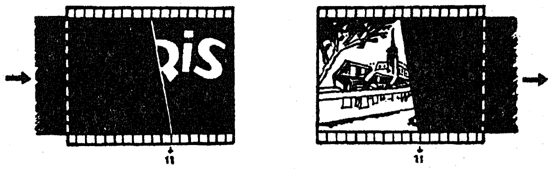
Advancing and Receding Titles

If the camera bracket can be moved smoothly towards and away from the title card, titles can be made to advance and recede from the camera.

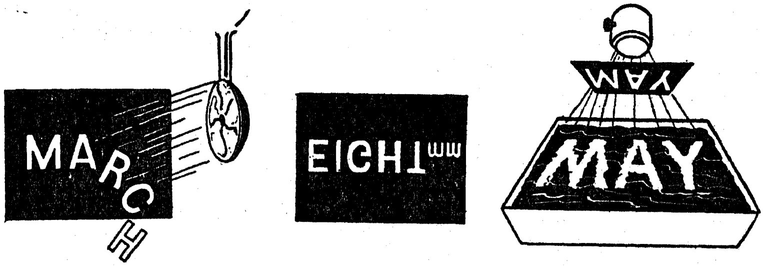
It is important to ensure that the title is in sharp focus in the position at which the camera comes to rest. The camera should therefore be focused in advance in this position.

If absolute sharpness is required throughout, you will have to expose single frames and refocus for each frame.





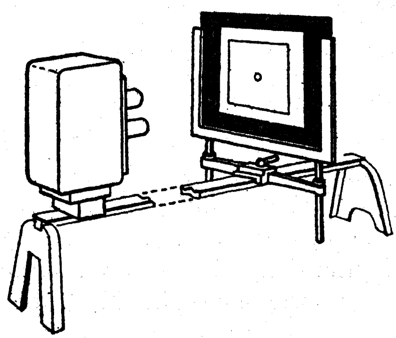
Transition by oblique wipe card moving along a graduated scale outside the filming area. Single frames are exposed throughout. First run: Title card in position (*top left*). Wipe "off" progressively with card positioned as *top centre*. Wind film back. Second run: Photograph in position, but covered by wipe card turned through 180 degrees. Wipe "on" progressively, moving card as *top right*. Successive phases then appear as on *left*.



Left: Title letters can be blown away by a fan representing a spring breeze. By inverting the text and turning the film round before projection, letters can be made to assemble themselves in order.

Centre: For reverse motion with 8 mm. film lettering must be inverted *and* reversed laterally. A slight loss of focus is inevitable with this gauge owing to change of emulsion position during editing.

Right: A title can appear reflected in a sheet of water. The inside of the dish is painted matt black and a special cut-out mask held between the light source and the water.



Some titlers have a sliding camera platform or title holder, enabling tracking shots to be made. Transitions are then possible from one title to another by bringing the camera and first title together until the lettering becomes blurred, then tracking back to reveal the second title.

Flap-over Titles

A rapid transition from one title to another, or from a title to an enlarged photographic still of the next scene in the film, can be made with the special flap-over accessory available with many titlers. The title card is made to pivot on a horizontal or vertical axis by means of a special crank handle.

Suggested duration for the pivoting movement is 3 seconds. If you plan to dissolve from one flap-over to another, the two flapping movements should take place in opposite directions. Make sure that the area behind the title card is in darkness.

Animated Titles

There are many uses for animation technique in titling, and it is sometimes combined with reverse motion (page 190) where the camera is used upside down.

Letters can be added one by one so that on the screen the title appears to spell itself out. A route can be traced in on a map and filmed in single exposures.

Wipe cards (page 173) will also serve for the same purpose.

Silhouette Backgrounds

If a ground glass screen is used as title background and illuminated from behind, it is possible to arrange a moving background using silhouettes such as leaves, projection spools, etc. As the background will be predominantly light in tone, it should be slightly under-exposed.

Revolving Titles

A special accessory available for some titlers, consisting of a revolving disc, enables titles to spin round and come to rest exactly horizontal.

To be certain of correct alignment when working with 9.5 or 16 mm. film, it is best to place the title upside down at the start, and use the reverse motion technique described on page 190.

Title Transitions

The main and end titles of a film should both be faded in and out. This can be done either by (*a*) opening and closing the iris diaphragm, (*b*) moving two polarizing screens in relation to one another in front of the lens (page 74), (*c*) moving the lights towards or away from the title, or (*d*) using a dimmer in the lamp circuit.

When one title succeeds another, the usual transition is by a dissolve (page 182). A direct cut looks jerky.

Transition from one title to another can also be made by altering the camera focus so that the title becomes blurred.

On a fixed focusing camera the close-up attachment can be removed to achieve this. Where the titler has a movable carriage, the camera can be moved rapidly towards the title then stopped while the title is changed. Shooting is then resumed when the new title is in position.

Wipe

Transition from one title to another, or from title to still photograph or drawing, can be made by moving wipe cards with matched straight, vertical or oblique edges horizontally along the titling area. Shooting takes place in single frames and the cards are moved along a graduated scale specially drawn well outside the titling area.

The operation takes place in two stages. Card No. 1 progressively covers over title No. 1. The film is then wound back to the starting point, title No. 2 is placed in position and progressively uncovered. Given accurate registration, the effect on the screen is of one image wiping the other off the screen.

Two pieces of card can also be moved apart like a curtain to reveal the title.

The use of wipe cards further permits title letters to be spelled out and routes on maps animated. Draw an outline map in white ink on a black background. Place a mask or masks over the names and align against a ruler to enable them to be withdrawn in a straight line.

First run the camera for two or three seconds with the mask

entirely obscuring the letters. Then stop the camera, uncover the first letter and expose two frames. Stop the camera again, uncover another letter, expose two more frames, and so on, until the complete word or title is revealed. Where more than one word is involved, expose three single frames between words.

After the whole text is uncovered, run the camera continuously for two or three seconds more (or give the equivalent number of single frame exposures).

A smoother effect is obtained if the individual letters are uncovered a bit at a time; but this does take longer.

When using movable letters there is always a danger of knocking them and upsetting their alignment. With 9.5 and 16 mm. apparatus the title can be composed upside down on the titler and the reverse motion method (page 190) adopted. First shoot sufficient footage on the complete title for the audience to take it in, then switch to single frame operation and remove the letters one by one, starting from the *end* of the text.

Cartoon Technique

The foregoing procedure can only be used with very simple outline maps. When maps contain more detail, it is necessary to adopt cartoon technique.

Two separate sheets of celluloid or other suitable material are required for the purpose and there must be arrangements for exact register (see page 214). Draw or paint the part of the map to be animated on sheet No. 1; those parts of the map that are to remain unchanged are painted, against a black background, on sheet No. 2.

Place sheet No. 1 by itself in position with the aid of register pins. Take careful note of the reading on the camera footage counter, and carry through the animation to the end. Then wind the film back to the starting point. Remove sheet No. 1, replace by sheet No. 2, and expose the same length of film again.

Titles over Action

A main title can be superimposed on the first shot of a film by composing it in white letters on a black background and

filming it at the beginning of a reel. The film is then wound back to the beginning, before filming the first shot of the action on the same length of film. If the camera has no back-winding mechanism, wind the film back by opening the camera in the dark or in a changing bag.

As the first shot is only intended as a background, there should be no rapid movement. Keep the tone values dark; slight underexposure, or a filter, is therefore recommended. A slow panning movement may be desirable to throw the white letters into relief.

When filming in colour, do not include clouds in the shot; they provide insufficient contrast for the lettering.

Fancy Backgrounds

There are many surfaces and materials that can provide title backgrounds. But the tone values must be restrained, or they will compete for interest with the lettering. Coarse surfaced paper, a discreet decorative pattern, a piece of cloth, wood or leather, or some feathers are typical possibilities.

To bring out the surface texture, oblique lighting will often be necessary. To facilitate correct lighting of the letters it may be desirable to make a photographic still of the background and place the letters on it.

Photographic Stills

Still photographs of actual scenes from the film itself are very suitable as title backgrounds, but people and moving objects should not appear in them. Keep the composition simple and the tone values subdued.

A library of suitable title backgrounds is a useful thing to have. It might include a landscape with clouds, a sheet of water with reflections, and a building with a contre-jour effect (to be taken with a filter and printed on a matt-surfaced paper).

If the size suits your titler, commercial picture postcards can be used for the same purpose. Beware of reflections from a glossy surface.

Letters Reflected in Water

This requires a sheet of cardboard, a sharp knife or razor blade, a photographic developing dish and a sheet of black paper the same size as the dish.

Stick the black paper to the bottom of the dish, fill the dish with water, cut the title word out of the cardboard and arrange for the beam of a spotlight to shine through the cardboard on to the dish where the word will appear as though mirrored on the water. Set the camera up and film the image in the water. At the end of the shot ripple the water to obscure the lettering. With 9.5 and 16 mm. cameras you can also use reverse motion (page 190) to make the lettering appear out of the ripple.

Alternatively, compose a title in white letters inside an empty dish, start filming, then pour water in to disperse the letters.

Humorous Titles

Animation technique (see page 203) enables title letters to be composed deliberately in the wrong order. A single letter can appear as if wishing to place itself in position before its proper turn.

Another trick consists in composing a title, but leaving all the vowels out until the last moment.

Back Projection

Titles can be superimposed on a moving background after the film has been shot. To do this copy the necessary footage for the background, wind the film back in the camera and superimpose the title.

The film is copied by projecting it from behind into the titling area on to a sheet of fine ground glass or tracing paper. To avoid a "hot spot" in the middle, the projector should be set slightly off centre.

Run the projector slightly faster than normal to ensure that the projector and camera shutters are out of phase. Alternatively, operate both projector and camera on single frames.

Correct exposure can only be found by trial and error, but as a rough guide a 500 watt projector giving a screen image about 5 × 7 inches will require a camera aperture somewhere between *f*2.8 and *f*5.6 with medium speed panchromatic film.

The film should be laced up wrong-way-round in the projector—or projected through a prism or mirror. Otherwise the copy will be laterally reversed.

An alternative method is to have projector and camera on the same side of an opaque screen. In this case the projected image should be kept small and the camera moved as close as the focusing movement of the lens permits. Using a 500 watt projector and filming from an 8-inch screen image, an aperture of about *f*4 with medium speed panchromatic film will be required.

Copies obtained by either method cannot, of course, match the original as regards quality or grain. But as the scene is only intended to act as a title background, this loss of quality may not be important.

Special Tricks and Effects

WHILE STRAIGHTFORWARD FILMING records life as it is, it does not necessarily show it most effectively on the screen. There are, however, a large number of cinematic effects and tricks with which the movie maker can enhance the impact of his films. Although the use of tricks may in a sense be "cheating" it is fully justified where such means serve simply to overcome the limitations of the subject both in space and in time. And even when tricks go beyond that, they can in fact become a medium of creative filming.

Scene Transitions

But let us get back to earth, and have a look at the simplest of all effects: namely scene transitions.

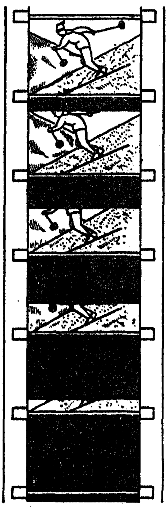
The most straightforward way of going from one shot to the next is a *cut*: the first shot is directly followed by the second one. This, however, is apt to get monotonous, and it also tends to disrupt the flow of the action. Special scene transitions are therefore frequently employed.

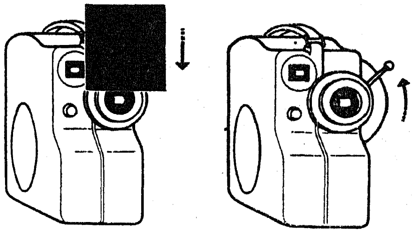
The effects in most demand are *fades*, *dissolves*, and *wipes*, which indicate a transition in the narrative by providing a gradual change from one scene to another.

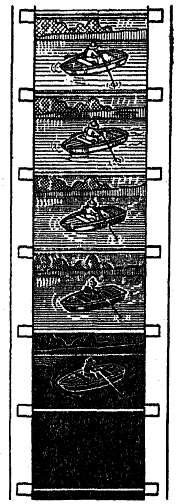
The Fade

The easiest transition, technically, is the fade.

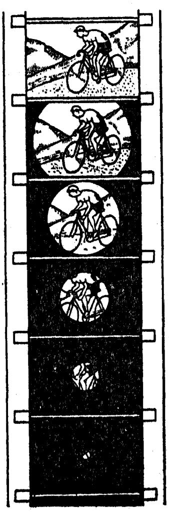
The opening title of a film *fades in*, remains on the screen for several seconds, and *fades out*. The first shot of the action then fades in.

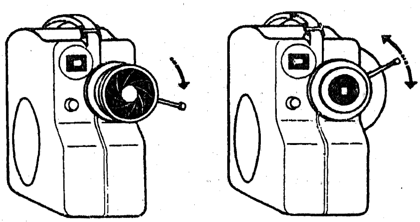


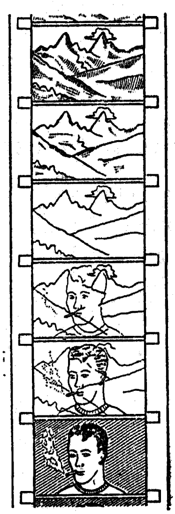




Left: A wipe is made by passing a black card over the lens. The card should preferably be fitted in the grooves of an effects box, and several inches away from the lens to obtain a sharp outline. The following shot is then wiped in by reversing the movement of the card. *Right:* A fade is made by opening or closing the lens aperture during a run. Most iris diaphragms do not close completely. To obtain a complete black-out hold the hand or some opaque object over the lens.







Left: A supplementary iris diaphragm fitted over the front of the lens produces a vignetting effect as it is closed down, providing another form of scene transition. At an intermediate setting the effect produced is that of observing the scene through a circular aperture such as a ship's porthole.

Right: A dissolve is obtained by fading out one scene, winding the film back and fading in the second scene in superimposition. Careful timing and adjustment of relative exposures are essential for success. Specialized 16 mm. laboratories are equipped to manufacture dissolves on processed film.

From that point on, the use of a fade generally indicates an appreciable lapse of time, or a considerable change of location. In terms of literature, it may be likened to a new paragraph—or even to the beginning of a new chapter. When only a brief passage of time is to be suggested, the fade is inappropriate; there it is better to use the *dissolve* (page 182).

A fade is normally made by opening or closing the lens iris, over a range of at least four whole stops. If the working aperture is f5.6, stop down to f22 for a proper fade out. As f22 is usually the smallest stop available, a working aperture smaller than f5.6, e.g. f8 or f11, does not leave sufficient latitude for a proper fade. In such cases, a colour or neutral density filter (page 75) can be placed over the lens to reduce the light and so call for a larger aperture. Or it may be possible to run the camera faster, so increasing the shutter speed for the same purpose.

To facilitate making a fade with the iris diaphragm, it may be possible to fit a special arm on to the diaphragm ring by means of a collar. This arm should come up against a definite stop at the exact position of the normal filming aperture. This will ensure that correct exposure is given after a fade in. A lever will further assist in overcoming the resistance of the click stops fitted on modern lenses.

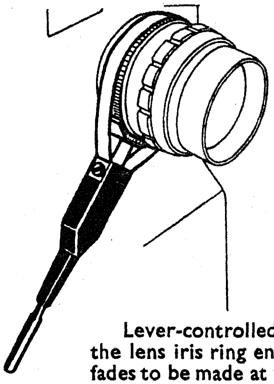
It is also sometimes possible to arrange a transparent aperture scale visible while filming.

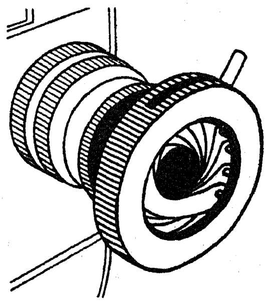
Fading Glasses and Other Methods

Special fading glasses, consisting of a strip of glass clear at one end and merging through all the half-tones to dense black at the other. On moving across the front of the camera lens, it gives a progressive change of exposure.

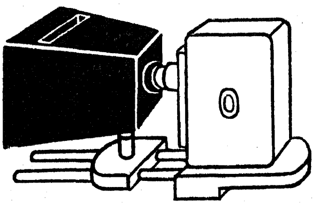
When shooting scenes in artificial light, it is easy to fade out successfully by dimming the lights, either electrically or by sliding cards in front of the lamps.

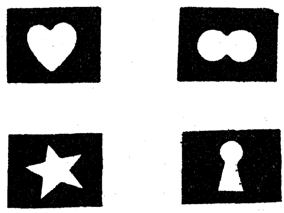
Fades can be made on processed film by chemical means. Reversal film can be treated in fading solution (a dye), which progressively darkens the image according to the time of immersion. If you use negative film in the camera you can get the



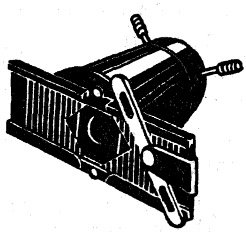


Lever-controlled lens apertures. *Left:* An accessory lever fitted over the lens iris ring enables the aperture to be adjusted while filming and fades to be made at will. *Right:* A separate, totally closing iris diaphragm is available for one make of lens. This is screwed in front of the standard lens and enables a fade to be made irrespective of the lens aperture in use.





An effects box has many uses. It consists essentially of a large lens hood (and is worthwhile for this purpose alone) fitted with a slot and/or channel for insertion of filters, and masks or mattes. Any desired shape of mask can be inserted in the box for special effects, e.g. binoculars, or keyhole. The box should be adjusted so that the mask is not less than about 5 in. in front of a 1-in. standard lens on 16 mm. or 9.5 mm. cameras, and at least 2½ in. in the case of a ½ in. standard lens on an 8 mm. camera.



Another type of effects box incorporates sliding masks for vertical and diagonal wipes. This device is designed to fit over the camera lens-hood. Two of the mounting screws are visible on the extreme right.

same result in the print by dissolving the negative image away in Farmer's reducer (a mixture of 1 per cent potassium ferricyanide and 5 per cent hypo solutions). The procedure in both cases is to lower the film progressively into a glass tube containing the appropriate solution, remove rapidly, wash in clean water and dry.

There are two other methods of producing fades, and neither is cheap. One needs an expensive camera, of the type having a shutter with a variable opening (page 138). The action here is simple: the movement of the lever on the camera causes the fade, and the blackout is complete. It is effective at any aperture of the lens.

The other method needs an expensive gadget incorporating a pair of polarizing filters. Again the action is simple: rotation of one filter against the other gradually leads to a complete blackout. This scheme is most suitable when filming at small apertures (unlike using the fading glass) because putting the filters on requires about 4 stops increase in exposure.

Dissolves

Dissolves are the most useful of the transitions, the smoothest means of connecting scenes. Unfortunately for the amateur, they are not the easiest to make.

In a dissolve one scene gradually fades away at the same time as another scene gradually appears and takes its place. It is the overlapping of a fade out and a fade in. But the overlapping must be done properly or the effect will not be smooth.

At the halfway point of a dissolve both scenes should be at half density, for the two to add up to full density. Therefore, when using the lens iris to produce the individual fades make sure that at the centre of each fade the scene is one stop underexposed and not less or more. A variable shutter gives no trouble in this respect since at the half-way position of the lever the shutter will be letting through half the light.

The procedure for making a dissolve is the least troublesome if the camera has a back-wind mechanism incorporated. You then merely fade out a scene, timing it in seconds; cover the lens and wind back the equivalent length of film. For the

second scene, run the film through the camera again, fading in the scene on top of the existing fade out.

Without back-wind facilities a reference point is required such as the beginning of the roll, for working out where the two fades will be. Rewinding of the film must be done in a darkroom or changing bag. Then reload the camera, cover the lens and run the film through to where the fade in will start in order to match the fade out.

Uses of the Dissolve

A dissolve can suggest the passage of a brief period of time without change of location, or a change of place without appreciable change of time. The point is, that the two scenes linked by a dissolve should have something in common—sometimes even some pictorial shape.

From a shot of a village with the short shadows of midday, we can suggest the passage of time by dissolving to the same scene with long evening shadows. Similarly, a shot of a living-room in its everyday state can dissolve to the same scene with cheerful decorations, indicating the approach of Christmas.

The same technique can be used to show the interior mechanism of machinery. You start with an exterior view, then superimpose a sectional or "exploded" view of the same thing.

Besides its uses for scene transitions, the dissolve can also indicate the thoughts of one of the actors in a scene. What is this girl thinking about? Her boy friend, perhaps? The dissolve shows that her mind is preoccupied not with love but with that dress in the shop window that she has set her heart on.

Making a Wipe

In the wipe, the scene is gradually obscured by a moving shape, which then recedes, revealing the next scene. Ready-made wipes for 8 mm. and 16 mm. film are available in the form of adhesive strips from photographic dealers. They are simply stuck on the film so as to overlap the end of one shot and the beginning of the next.

To make a wipe in the actual film image, you need an effects box. This box also serves to make other special effects described below, but which do not provide scene transitions, so this is the moment to describe its construction.

There are two basic designs for an effects box. One is a large lens hood, with extra fittings on the front. The other is a metal or wooden base, held between the camera and the tripod, that can hold up attachments in front of the lens. The front of the effects box carries guide slots which take any of the card attachments needed. Paint all internal surfaces black.

For the greatest efficiency the gadget should have an oblong aperture in the front plate just larger than the angle of view of the camera. You are then able to tell just how much of the field of view your cards will be cutting off; you can also tell where the centre is, to get the masks symmetrical.

It is important that you can separate the camera and the effects box and at any time put them together again, knowing that they will register exactly. Otherwise there is no point in having an accurately made front masking plate. Registration strips as on the titler will be suitable for the base-plate type, and the lens hood type can have a mark on it that will align with a mark on the lens mount.

The most popular way of making a wipe in an effects box is to slide a piece of card progressively across the lens. The usual wipe moves horizontally, but sometimes vertically or diagonally.

This is where the effects box helps in getting a neat result—wipes made by pushing the hand in front of the camera or moving a hand-held object are apt to be crooked and irregular. The effects box with the accurate rectangular opening at the front shows exactly what is going on.

Fan wipes or pendulum wipes can be made by swinging a card across the front on a pivot pin below or above the lens.

These wipe-fades although somewhat hard and obtrusive have an advantage over fades—they do not change the colour balance of colour film. The portion of the scene that remains visible as the wipe proceeds retains its proper colouring to the end.

Iris wipes, which show on the screen as a diminishing circle, can be made with the aid of a totally closing iris diaphragm which is made for some lenses and can be attached to the front of the camera. It consists of an iris similar to that built into the lens but can be completely closed to exclude all light.

A serviceable substitute for the specially made item can be a large adjustable iris from an old long-focus lens, even if it does not close completely.

When left in the half-closed position, this iris can be used as a round mask giving the impression that the shot was taken through some feature in the foreground. As in the case of masks used in an effects box, the shorter the focal length of the lens and the smaller the lens aperture in use, the sharper will be the rendering of the edge of the iris itself.

Painted Wipes

It is not always possible to anticipate the need for a wipe at the time of shooting, so an after-thought version may be welcome. That is the painted type, obtained by progressively blackening parts of succeding frames of the film with opaque ink. The ink used is a black quick-dryer normally used for blooping sound tracks. Indian ink is not suitable—it only cracks as it dries. Blooping ink must be painted on the celluloid side.

Several designs of wipe are possible. The two most popular are the "straight across" and the "curtain". The normal screen time of a wipe is between one and two seconds—20 frames for films shot at 16 f.p.s.—30 frames for 24 f.p.s. is a good average. In painting these wipes, use lines to guide the brush; scribe them lightly on the celluloid side of the film with a needle.

Natural Subject Wipes

There are many subjects which can be made to provide their own wipe transition. In a mid-shot, a person moving towards the camera comes right up to it until his body entirely blacks out the view. Another person in the next shot performs the same evolution in reverse, starting close to the camera and moving away until the action is revealed.

For instance to indicate that a man is preparing for a walking tour, let him walk right up to the camera in normal dress, until his body blacks the scene out. For the next shot, have him wearing a rucksack, place him facing away from the camera and close up against it, and tell him to start walking.

Transitions of this kind can often be found amongst existing shots which were not filmed with that purpose in view. Some research with an animated editor may therefore produce useful results.

Transitions by Panning Shots

A somewhat similar effect can be obtained by camera movement. At the end of a shot, the camera pans away to a dark surface such as the arch of a bridge. The difference in tone value between the background, which is fully illuminated, and the foreground in shadow ensures that the vital view will have the necessary degree of under-exposure.

Transition to the following scene (which need not actually be filmed in sequence) is obtained by starting the shot on a dark foreground then swinging away to reveal the new scene.

The sky, or a sheet of water, can also be used as a link by panning up to it at the end of one shot, and starting the next shot in the same way.

When shooting colour film, it will be necessary to watch the relative colour balance of the two shots that are to be projected in sequence.

Zip Pans

A zip pan is made by swinging the camera rapidly away from a scene so that the image becomes blurred. The next shot is introduced in the same way by starting on a blur and whipping the camera round on to the action.

This is a useful transition but should not be abused. It can also be used for other than trick purposes, in order to draw attention successively to persons who are not all in the same field of view but yet not very far apart.

Use of the zip pan in this context serves to heighten tension

and suggest drama. A typical example would be a rapid pan from the revolver seen in the hand of a criminal towards the anguished face of his victim.

Speed Tricks

We come now to actual trick effects made in the camera during shooting. Since the cine camera is an instrument for recording movement, the most obvious means of deliberate control consists in varying the rate at which the camera records it. In other words, there is extensive scope in altering the camera speed, and the different ways of achieving this can be utilized for amusing and clever effects as well as for serious purposes of motion study.

Slow Motion

Slow motion is obtained by running the film faster through the camera—the action is spread out over a longer strip of film. This will take longer to go through the projector, thus stretching the action and making it slower.

The amateur's maximum speed is 64 f.p.s. and this makes it possible to observe action that is too fast for the naked eye. Sports events can be analysed at leisure, machinery and other fast moving mechanisms can be studied, and beauty revealed in the breaking of an electric light bulb. You can also create slightly comic effects as, for example, by slowing down a fine pair of jitterbugs in action.

The running time of a slow motion sequence should be based on the final projection time required. If a scene is to last for eight seconds on the screen when projected at 16 f.p.s., you will have to film for 2 seconds at 64 f.p.s., or 4 seconds at 32 f.p.s.

This matter of timing is important for two reasons. The first is economy, for you will not want to use any more film than is required to do the job. The second reason is that the camera spring runs down proportionately faster. If the camera will normally run for 20 seconds at 16 f.p.s., it will only run for 5 seconds at 64 f.p.s. The majority of cameras require up to half a second to attain the full speed of 64 f.p.s.; allow for this at the beginning of the shot.

Never run the camera at 64 f.p.s. unless it is loaded with film. An empty camera will race beyond this and most manufacturers issue a warning about it.

Remember also that when the camera speed is altered, the lens aperture must be adjusted to compensate for the difference of exposure time (page 130).

When the camera runs *slower* than normal, the lens aperture must be *closed*, and vice versa.

An important use for slow motion is to slow down the movements of models that have a movement of their own, independent of animation: for example, a burning model with flickering flames, a train crash or a building falling over. If the models are shot at normal speed they are recognized at once as models, however well made they are. Shoot them at 64 f.p.s., or as near to that speed as possible.

Speeds only slightly faster than normal—24 to 32 f.p.s.—have an occasional use for effects not recognizable by the audience as slow motion. For example, dancing may be made to look more graceful, or an actor's quick gestures can be slowed down to be more natural.

Fast Motion

With the speed control set to 8 f.p.s., all motion on the screen will appear to move at twice its original speed. Comedy effects are then quite easy. Fast pedestrians and traffic are fun to watch, especially at crossroads where they tend to get mixed up more. The hero can run twice as fast when being chased round a field by a bull.

There are other, more serious, uses of speeded up motion. Staged car chases and car accidents can be made to look more dangerous. Storm clouds can be made more turbulent. Acrobatic larks and selected sports activities are more impressive when speeded up slightly—say, 12 f.p.s.

A further practical use for 8 f.p.s. is to make the lens the equivalent of one stop faster when working under difficult lighting conditions. The subject must, of course, be static or near-static or it will show exaggerated movements: titles are a possible example.

Stopping the Camera

If you stop the camera temporarily during a scene, make a change in that scene and then start the camera again: the result on the screen will be a sudden magical change.

A tripod is necessary to keep the camera still while the change is made, otherwise the effect will be ruined, but the trick presents no real difficulties for even the most modest amateur. You may change an object into anything you fancy, at the wave of a wand. When actors are in the scene, they too must keep absolutely still while the change is being made.

Here are some examples of what can be done by this method. Candles on a Christmas tree can appear to light themselves. Any desired number of puppies can be made to crawl out of a dog-kennel. A numerous family can be made to emerge from a small two-seater car. A diver can disappear in mid-air after jumping from a spring-board. A stretch of deserted railway line can conjure a train out of nowhere. An unfortunate person can grab at a series of objects which all elude him and disappear. A lazy student can put out his hand for a novel and find in it a treatise on mathematics.

Stop-Motion Procedure

Where inanimate objects are involved, shooting presents no difficulty. The candles of the Christmas tree can be lit one by one, a single frame being exposed each time. The same method can be used to produce the effect of a set of crockery laying itself on a table, piece by piece.

The diver is made to disappear by stopping the camera when he is in mid-air and resuming shooting after he is out of sight. The appearance of the railway train is similarly arranged by filming the track before the train appears, waiting for the train to appear and starting the camera when it is well in the picture. The same effect can, of course, also be applied to aeroplanes arriving at airports and to the evolutions of sportsmen and skiers.

When the two-seater car is to disgorge its numerous occupants, the sequence must be planned so that the exact spot

where the car is to come to rest is known and the viewpoint must be chosen so that the interior of the car is not clearly seen. The first two occupants get out, leave the door open and start walking without leaving the field of view. The camera is then stopped. Two more members of the family party then get into the car and the previous routine is repeated as often as you wish, with intervals for refilling the car with occupants when the camera is stationary. When the last occupant has finally shut the door, you have one more gag up your sleeve. Just as the group is about to walk away—and the camera is always in the same position throughout—the door opens once more and we see the youngest member of the family hurrying to rejoin his brothers and sisters.

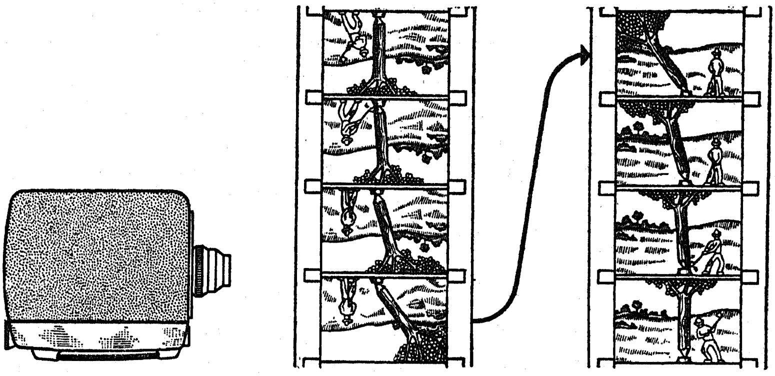
Reverse Motion

If the camera is held upside down when filming, the film runs through it in the reverse direction relative to the subject. So when the shot then spliced in so that the image is the right way up for projection, it will be found that the action appears to take place in reverse.

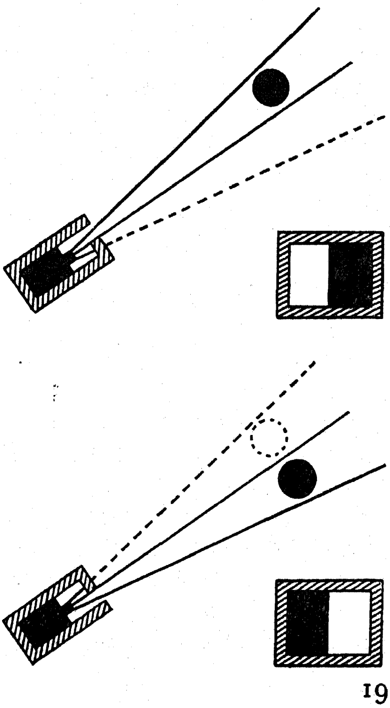
The resulting reverse motion can have many applications, both humorous and serious. For titling, letters can be added one by one so that on the screen the words appear to spell themselves out.

In the case of 8 mm. film, the fact that there is only one row of perforations makes it necessary to splice the reverse-action shot in with the emulsion on the opposite side. As a result, there will be a loss of focus on projection; and any lettering that may appear in the shot will appear laterally reversed. While there is no remedy as regards the focus, lettering can be made to appear the right way round if it is possible either (*a*) to compose it as in a mirror image, or (*b*) film it through a right-angle prism or 45 degrees mirror.

A typical trick that will amuse children is to cause a pile of bricks on the carpet to jump up and build themselves into a castle. First build the castle, and fasten a piece of black cotton to it so that a pull will bring it down. Shoot with the camera upside down, and pull the cotton while the camera runs.



Reverse motion is produced by filming with the camera upside down. On turning the finished film round so that the image appears the correct way up for projection, the action appears to take place in reverse on the screen. The inverted camera records successive frames (*centre*, from top to bottom) of the tree falling. After processing, the film is turned round so that the last frame exposed is the first to be projected. Reverse motion is less satisfactory with 8 mm. film as the resultant image appears the wrong way round.



Split Screen. Double exposure enables an actor to play two roles in one scene if one half of the picture area is masked off for each "take" and the film is wound back in between. Requirements are an effects—or matte—box and suitable masks which must be fitted in accurate register. With a 1-inch focal length lens, the masks should be about 5 inches in front. The right hand side of the scene is masked off for the first take, and the actor plays his part in the left hand side. The film is then wound back, and the left hand side of the scene masked off. The actor then plays the other part on the right hand side. The actor must take care not to move hands or legs beyond the area being filmed.

Staging a Car Accident

Another class of tricks that need reverse motion to make them possible are the scenes of car crashes and other incidents that it would not be safe to shoot forwards. It is here that the method offers most scope for serious work—that is, using the upside down camera but organizing all the action in reverse.

A car accident can be built up in a number of ways but here is an example of a realistic one-shot incident.

In a M.L.S., have the actor lying on the ground face upwards under the bonnet of the stationary car, with only his head sticking out. When the car slowly backs away from him, the actor rises as quickly as he can so as to be in contact with the radiator for a few moments, and holds his arms in front of his face. Then he stands still to let the car draw away from him. Before the car goes out of picture, the actor lowers his arms and appears to scream. He may then cease to look terror-stricken and takes a few steps backwards. All this is filmed at 8 f.p.s.

When the scene is projected, with the film of course running forwards, it will appear that the pedestrian sees the car too late to avoid it, registers horror and is run over. An amusing incident can be staged if someone walks backwards in a crowd of pedestrians, and you film him with the camera upside down. His behaviour is sure to cause surprise, and when the scene is projected after the film has been turned round the audience will see a street full of people walking backwards looking in astonishment at one man walking forwards.

Single-Frame Shooting

A camera fitted with a single-frame release can give greatly accelerated motion. If you press the release once every second, the motion on the screen will be sixteen times faster than normal. Any desired length of time can be allowed to elapse between the exposure of single frames and therefore movement lasting some hours can be condensed into a few minutes of film.

An essential piece of equipment for this class of photography

is a sturdy mount for the camera. A cable release is also desirable.

The easiest use for stop motion is in filming such self-moving objects as clouds, traffic at the crossroads, or a football match taken from the top of the grandstand.

For instance, to try a sunrise, mount the camera on a tripod and aim it towards the east. As soon as the sun begins to appear over the horizon expose a single frame every two seconds. Keep shooting until the sun is fairly high in the sky—15 minutes will do. On the screen, the 15 minutes of sunrise will last just 30 seconds.

Single-frame motion can also be used for comedy effect. The luggage of a party of people setting out on holiday can be placed on the front doorstep and then made to appear to pile itself without human aid into the boot of the car, which opens for the purpose unaided. Similarly, by exposing one frame at a time and moving the object very slightly between each exposure, a toy dog can be made to follow its master out for a walk. This is in fact the beginning of animation proper (page 203).

Time Lapse Photography

Very slow-moving subjects such as plants, crystal growths and some chemical processes need to be filmed with greater intervals between each exposure. Here automatic mechanism is required to switch on the lights, operate the release, and extinguish the lights again. Units can be obtained ready made, or you can make up your own.

Time-lapse photography is a valuable scientific aid as it facilitates the study of phenomena that would normally require hours or days of observation. The technique is by no means beyond the scope of the resourceful amateur.

Masking Tricks

Going on to a further stage there is a wide range of possibilities of showing in a film things that were never there—at least not in the same way—in fact. This type of effect covers all the various double-takes, ghosts, and combination tricks. They are widely used in professional motion picture technique—not in

order to make the impossible look easy, but to convey moods and impressions, as distinct from realism in statements. The majority of these image effects rely on masking the image in one way or another during shooting. In its simplest form the mask, or matte, is a cardboard attachment that alters the shape of the normal frame, or screens off part of it. A firm mounting for it on the camera is essential and the mount should make quick, accurate centring possible—in fact, you need some form of effects box (see page 184). Where the mask is only used to alter the shape of the frame, standard designs are a circle (representing the view through a telescope); two linked circles (for a binocular effect); and a keyhole to fit a Peeping Tom scene.

Split Screen

Using the effects box, it is possible to make a mask cover part of the scene being filmed and then, after winding back the film, use another mask to cover the portion already exposed, and expose a scene on to the part previously masked. This is the split screen technique.

The fact that the two parts of the scene are exposed separately means that for the best results the camera must be free of *gate float*. Otherwise the two halves of the scene will move about in relation to each other and give away the split.

The masks used to split the screen are mounted within a few inches of the lens so the edges are out of focus on the film and they merge into each other—provided that the edges of the masking cards coincide in the effects box guides. Fortunately it is easy to make them coincide if you use *two* masks that can be slid into the guides from opposite ends.

Adjust card No. 1 in the guides until its edge coincides with a natural feature of the scene, such as a vertical line of a door. This helps in taking the audience's attention away from the split. Film that half of the scene and rewind the film. Now change the masks: push card No. 2 into the guides until it touches card No. 1 without air space showing, and then remove card No. 1. This method ensures exactness without guesswork, and you are ready for the second exposure.

A person can also play a scene with his or her double by the split screen method. The setting should be in quiet tones without obvious lines or other prominent features. Mark out clearly the area within which the actor can move.

Now place one of the half masks in position in the effects box. The actor plays the first scene, taking care not to go beyond the half-frame area, especially with his arm movements. The film is then wound back, the first mask removed and the second mask placed in position. The actor finally plays the other part in the other half of the frame. He can, of course, change costume and/or make-up between takes.

Scenes of this kind should be short and to the point. Rehearsals must be timed by stop watch to ensure that the facial expressions and gestures of the two halves of the picture will match one another.

Another easy trick is to make a person disappear as he walks up or down a flight of stairs. In this case a half-mask is placed horizontally in position to cover the lower half of picture area. A long shot is then filmed of the person walking downstairs. The film is wound back and the other mask inserted, covering up the upper half of the picture area. This time the empty staircase only is filmed, and the final result is that the person progressively disappears as he walks down. By reversing the procedure, the person can be made to disappear on the way up.

The same technique can show a man walking about apparently without legs (horizontal masks), or a group of children emerging by magic from a tree in the centre of the picture (vertical masks).

Superimposition

Split-screen shooting involves double exposures and the two parts of the scene are side by side. Superimposition also involves double exposure, but here one scene is on top of the other so that both occupy the same space.

Superimposition can not only put moving backgrounds on titles; it can portray dreams. thoughts, and ghosts; add rain to a scene; make morse code flash across the screen in front of action scenes; and add one live scene to another.

The technical requirements for superimposition are:

1. The two images must not interfere with each other. That is, their highlights must not overlap too much and burn out those areas, losing detail.

2. The camera should be free of gate-float.

3. The camera must not be moved between exposures unless the scenes are different.

4. Exposures must be judged so that the scenes match each other while maintaining the correct final density.

5. Timing must be accurate.

Superimposition is often used in the professional cinema to obtain *montage* effects. An impression of busy urban life may be given by superimposing different shots of streets, buildings, cinema and theatre queues, factory workers reporting for duty, buses and underground trains. Such scenes would be tedious if filmed and projected in sequence, but through superimposition a general effect of bustle results. A definite rhythm can be imparted to these scenes by alternating brief and longer shots and in appropriate cases tilting the camera one way or another.

Superimposition also provides an alternative to cross-cutting. A man out on a country walk hears cries for help. We see him rush off in the direction of the cries, off screen. More point is given to his reaction if we superimpose a child's face on the actual shot, showing him running from the distance towards the camera.

The general routine of superimposition follows the same procedure as for dissolves. Both runs must be calculated from the same reference point on the film. With charger loaded cameras the most convenient place is at the start of a roll; with the more expensive cameras that have backwind and a frame counter, the whole business is much easier.

Do the timing with a stop watch. Get an assistant to watch the footage counter or stop watch and call out timings while you operate the camera and keep your eye on the subject.

Exposure Calculation

Relative exposures are important. Each of the two scenes to be superimposed should be under-exposed by one stop. That is,

each receives one half the exposure it normally needs so that the two halves added together make one normally exposed image.

To ensure that both images are clearly seen, they should have contrasting tone values. If a man is shown fishing and we superimpose a close shot of a watch indicating that it is time to go home, it should appear against a dark background such as the arch of a bridge. If superimposed on a shot of the sky, it would not be distinct.

As one cannot always anticipate, from one shot to another, what the total effect of superimpositions will be, it is a good idea to film one of the two shots with a panning movement. This ensures that at a given moment there will always be some lighter tone to provide a contrast and show up clearly against a dark background.

Ghosts

Superimposition can also create transparent ghosts. You have a choice of two methods.

You may first film the empty scene one stop under-exposed. Then, after rewinding, film the same scene with the ghost present, again one stop under-exposed. The room is thus correctly exposed and the transparent ghost is at about half density.

The second method is to film the empty scene at its correct exposure. For the second run-through, film the ghost against an all-black background, under-exposed by half to one stop. This method enables live, solid characters to be present in the scene with the ghost because they are on the part of the scene that has had full exposure the first time.

To make a dream sequence where a person gets out of bed while his "other self" remains asleep, use a neutral background that is large enough to enable all movement to take place against it. Supposing a child is dreaming of Christmas. We start with this child asleep. Then suddenly the child's "double" comes wide awake, gets up from the body of the sleeping one, and jumps down on the floor. The audience notices with surprise that the furnishings of the room are visible through his

body as he walks towards the Christmas tree with its decorations.

The Christmas dream sequence is filmed as follows. First estimate the over-all duration of the shots. Then film the first sequence of the sleeping boy for a corresponding time, taking care that the camera is firmly stationed and does not move. Rewind the film to the beginning without moving the camera from its position. Finally, remove any chairs and other small pieces of furniture visible in the foreground, and make the second exposure. In this the child throws back the blankets, gets up and walks off in the desired direction. It is easy to see why the furniture does not offer an obstacle to our sleep-walker. And as the action is supposed to take place at night the silhouette of the child in pyjamas will be clearly visible in the foreground.

Ghost Images by Reflection

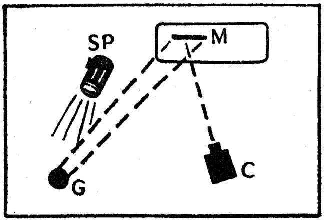
Ghost images can also be made to appear against a normal background by placing a thin sheet of glass between the camera and the main subject and adjusting it at an angle so that it picks up an image of some strongly illuminated object out of frame. As in superimpositions, the relative tone values of the main and ghost images must be carefully balanced. This method probably works best with small toys, cut-outs, etc., in which lighting and arrangement is well under the control of the cameraman.

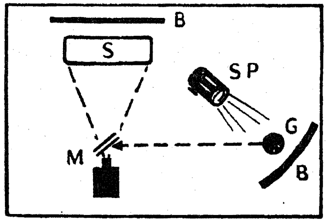
Two ordinary mirrors placed edge to edge can also make a single object appear multiplied twice or four times on the screen according to the angle of the mirrors.

Soft Focus Effects

Modern anastigmat lenses are highly corrected and give excellent definition. But there are occasions when a softer result is desirable. In the professional cinema it is common practice for large close-ups of female stars to give a deliberately soft rendering of the features and complexion.

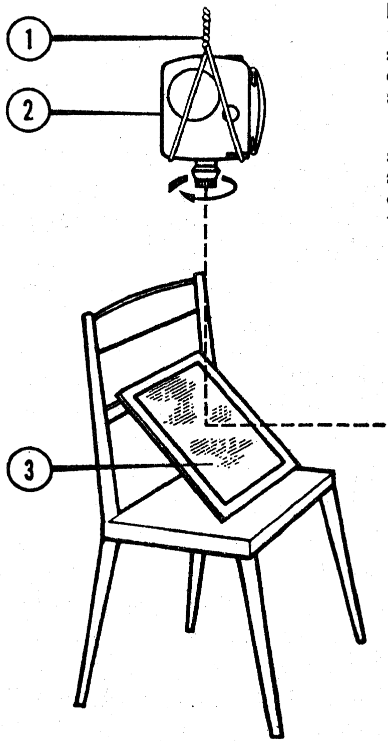
The purchase of a special soft-focus lens is hardly justified





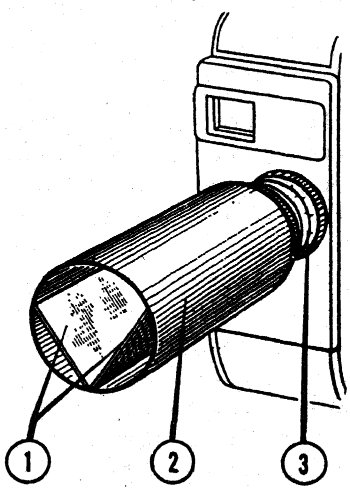
Above left: Ghost images can be produced with mirrors. The camera (C) is set up facing a normal mirror (M). The mirror is adjusted so that the ghost image (G) is visible from the camera standpoint. The image can then be made to appear framed in the mirror by switching on the spotlight (SP) and/or pivoting the mirror.

Above, right: To superimpose a ghost image on a normal view, a half silvered mirror or plain sheet of glass (M) is placed between the camera and subject (S) and adjusted so as to reflect the image of the ghost (G). The latter is illuminated by the spotlight (SP) and placed against a black background (B).



Left: To obtain a revolving image a length of stout cord (1) is used to hold the camera (2) suspended lens downwards and facing an inclined mirror (3). The cord is twisted, and allowed to unwind as the camera runs.

Below: Multiple images by a kaleidoscope. Two mirrors (1) are placed at an angle in a cardboard tube (2) fitted over the camera lens (3). Multiple reflection produces a symmetrical image pattern around a central point.



for amateur purposes. One way of obtaining diffusion—and it must not be confused with faulty focusing—is to use a diffusion disc available for still photography, consisting of a piece of glass bearing a pattern of squares or concentric rings.

A piece of fine grey or black cloth, placed in front of the lens, gives a diffused effect suitable for some close-ups of women and children. With white muslin, the scene appears to have been shot in fog. It is also possible to create the impression of increasing diffusion by placing successive layers of cloth in front of the lens till the scene is completely obscured.

Most sewing boxes will be found to contain odd pieces of cloth which can serve the purpose. After practical tests, the chosen sample can be mounted in the cardboard or metal frame such as used for minature still camera transparencies, to facilitate holding in front of the lens when shooting.

If the centre of the cloth is burnt with a lighted cigarette, the image will be sharp in the centre and gradually more diffused towards the edge. A fade can be obtained by mounting several layers of cloth in a series of slide holders and turning them like the pages of a book in front of the lens.

When dark toned cloth is held in front of the lens virtually no alteration in aperture is required. A light toned fabric gives an impression of over-exposure and the lens should be closed by half a stop to compensate for this.

Distortion Effects

Deliberate distortion may be used to illustrate the state of mind of a person. Thus, the heroine may suddenly get some bad news, and we now see her surroundings as through her troubled eyes. Or perhaps a friend has been out celebrating, and the next day his hangover gives him a very unclear view of his surroundings.

Deliberate distortion can be produced either by turning the lens out of focus or by filming through smoke, hot air from a cigarette lighter held below the lens, a piece of poor quality glass or ordinary glass slightly greased, or a sheet of crumpled gelatine. Distorting mirrors in fun-fairs can give very humorous effects. Motor hub caps and photographic glazing plates are other accessories that come to mind.

Multiple Images

Apart from superimposition (see page 195), multiple images may be obtained optically by using a special prism in front of the taking lens. If the prism is fitted in a rotating mount, the image can be made to revolve round itself. The effect is best judged by rotating the prism in front of the eye before placing it on the camera for shooting.

A neutral density filter placed over one of the sides of a double prism will make the corresponding image appear darker on the screen. One prism face can also be completely masked off if desired.

Trick Reflections

A person's reflection on a sheet of water can by made to disappear by placing a polarizing filter in front of the lens and rotating it while the camera runs.

By means of a mirror or mirrors, the cameraman can introduce himself, and his team, to the film audience. He can aim the camera towards a mirror, taking care that the mirror frame is not in the picture, and stand so that the camera records his own face. With a three-faced mirror the two side panels can be used to reflect the images of two more persons. A succession of actors can also be made to appear by pivoting the side panels so as to reveal fresh faces each time they are swung back into position.

In story films mirrors can also bring portrait photographs to life. If a man is seated at his desk writing a letter to a lady, we place a mirror on the desk where the writer—and the camera—can see it. The lady in question then stands, out of range of the camera, in such a position that her face is reflected in the mirror when suitably illuminated. But when the scene starts, she remains in darkness so that there is no image in the mirror that is doing duty for a portrait. Then first shoot the man writing; as he stops, and looks towards the "photograph"; turn the light on the lady, and her face appears in the mirror. She remains still for a moment, then "comes to life", smiles and speaks to her correspondent.

Silhouettes

The professional cinema makes considerable use of silhouettes, either in the form of shadows cast from sun shining behind the camera, or images seen on ground glass and lit from the other side. Typical examples are a gangster with his gun, and a lady in her boudoir.

Silhouettes outdoors are easy to make when the sun is shining, the only necessary precaution being to ensure that the cameraman's own shadow does not appear in the picture.

For interiors, a 250 or 500 watt spot lamp can be used to cast an image towards the camera on some bright, smooth surface. The closer the person or object is to the surface in question, the sharper the contours. The person or object must not appear in the frame. If no frosted glass is available, a white sheet can be used for a screen. It should be lit powerfully from behind while the side towards the camera remains unlit.

Making Your Own Weather

Provided you are only filming a small area in close-up, rain can be simulated with the aid of a garden watering can held by an assistant standing on a ladder and seen pouring on an umbrella or down a window pane. The garden hose may also be pressed into service.

Lightning effects are obtained by firing ordinary flash bulbs while the camera is running. To ensure that the flash does not go off while the camera shutter is closed it is best to fire two or three at the same time. A lightning effect can also be achieved if two polarizing filters are available and can be so adjusted to darken the image suddenly and then bring it back to normal density. The effect in this case must be carefully rehearsed and the orientation of the filters and exact lens aperture determined.

To imitate hoar frost dilute magnesium sulphate in a small quantity of beer. This should be done well in advance and the material spread on a flat surface and left to dry. Another method is to smear a sheet of glass with lemon peel and pour powdered sugar on it. If the glass is lit at an oblique angle this can be very effective.

Snow is difficult to imitate, but if close-ups only are required, boric acid or flour can be used. An artificial snowfall should be filmed with the camera running faster than normal, and snow on the ground can be imitated with boric acid and hypo. Salt and plaster, though they give a somewhat flatter effect, are also acceptable.

The pictorial quality of all frost and snow effects is enhanced if an orange or red filter is used on the camera, especially for storm scenes. Realism in black and white is increased by placing black gauze in front of the lens.

Artificial Fog

When the script calls for a foggy day, it is unlikely that real fog will be present. To simulate fog, you need smoke. But rather than cause a conflagration by lighting a fire for the purpose, it is preferable to use special smoke bombs which can be obtained from firework manufacturers.

Animation

Animation is an elaboration on stop-motion work in which the film maker moves the subject himself, according to his own schemes. The subjects may be alive; or models and other three-dimensionals; or drawings and other two-dimensionals.

The many maps that were used during the war on the cinema screen to indicate the movements of troops gave an excellent illustration of the simple animated film.

To do this kind of work you once again need a rigid camera as well as an immovable base for the items that you intend to animate. This is where a vertical titler (page 160) will be extremely useful because it permits the movement of small objects around on the easel without having to secure them in place between each exposure.

Live Maps

As an exercise, try producing a simple animated diagram to liven up a travel film. Film a map of the area concerned for a

few seconds (of screen time): then add the line of your route little by little, exposing a single frame for every small addition.

Arrows or other symbols can be introduced, and, with good animation timing, the illusion of the lines and arrows forming themselves will appear when the film is projected.

A dotted line is the most satisfactory because it is not easy to draw a smooth continuous line when making it up from short sections. To aid in drawing the line, either have a faint line of pencil dots, or use a cut-out sheet of cardboard placed with its shaped edge lying along the proposed route to guide the pen or brush. The sheet of cardboard is fixed down with two drawing pins along the edge that is out of picture and it can be folded back out of the way for each exposure.

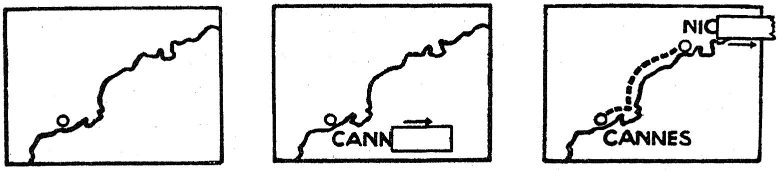
If you are working with a 9.5 or 16 mm. apparatus you can use reverse motion technique (page 190) to obtain a continuous line. Paint the complete line on a sheet of celluloid laid flat on the map, and place the map upside down in relation to the camera. Expose single frames, removing the line bit by bit, either by scraping gently, or by wetting and rubbing away (depending on the type of ink).

For 8 mm. users this method involves extra complication as any lettering will appear laterally reversed.

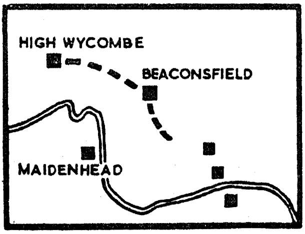
Here is another interesting method that can be used when the paper is thin enough to see through. It comes in handy for making any form of animated graph. A guide sheet is prepared showing the completed line divided up into the animation distances. This is pinned down under the map or blank sheet of paper that is to receive the growing line, and in this position the guide line can be traced as required. To prevent the guide line showing during the exposure periods, slide a sheet of white cardboard in between the two sheets.

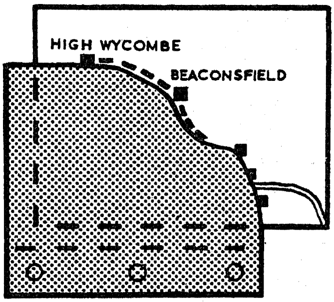
Articulated cut-outs, which are a cross between a puppet and a cartoon, may be made from sheets of thin cardboard. Heads, arms and legs can be pinned in position and moved as required.

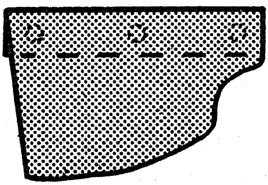
To ensure that the joints do not show on the screen it may be advisable to treat the figure as a silhouette moving against a light grey background.



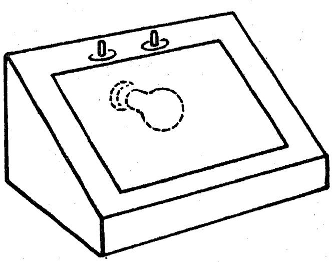
An animated route map enhances the interest of a travel film. Start with the place names covered over. Expose sufficient film to give the audience time to take it in. Uncover the first place name one letter at a time, exposing 2 frames after each move (3 frames if the film is to be projected at 24 f.p.s.). Draw in the dotted line (2 frames per dot), and finally uncover the name of your destination at the same rate as your starting point.

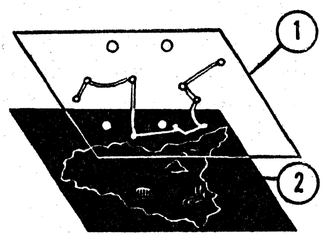






When tracing in a route on a map and exposing single frames, a folding guide or template helps to make a regular line. Cut the guide to follow the intended route and anchor it in position outside the frame area. Fold it out of the way when making the exposures.





A route can also be superimposed on a map by double exposure. *Right:* Route (1) and map (2) are drawn on separate sheets of celluloid or "cells". These are placed together in register and punched in two places to fit pins outside the filming area. The map can be illuminated from behind by means of a special light box with ground glass screen (*left*). First film cell (1) only against a plain black background, uncovering the route progressively, and exposing single frames. Rewind the film to the starting point, and expose the same footage on cell (2) only.

Movement Study

Before embarking on serious animation work, it is necessary to study the rhythm of human and animal movement.

Different human movements and gestures take place at different speeds. Simple movements, e.g. turning the head, raising an arm, moving a leg forward, can be watched in a mirror and timed by stop-watch.

The best way to study complicated movement is to run through a film of live action on an animated viewer and watch the changes frame by frame. If you are skilled at drawing, you can make lightning sketches of characteristic attitudes as you go along.

Keeping a Record

A detailed record is essential for even the shortest animated sequence. Memory is far too unreliable and this kind of work has to be done methodically. Frame by frame shooting is a long business and there will be many interruptions, perhaps lasting over a period of days. Some scenes may even have to be reshot.

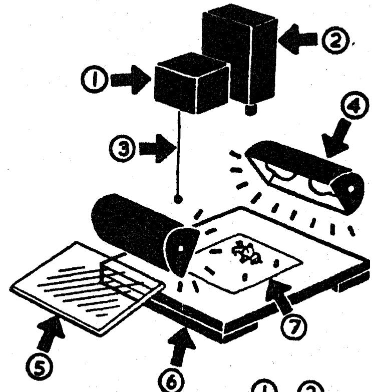
The record, or "dope sheet" as it is known professionally, should include details such as duration (in terms of screen time), accessories used, camera angles, lens aperture, and position and distance of the lamps.

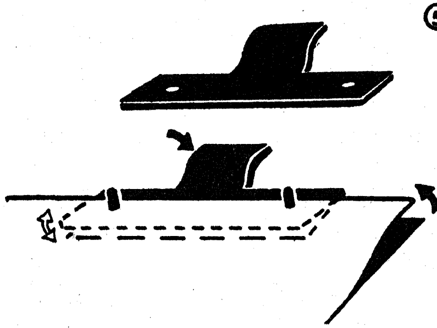
Special effects are most valuable in animation work: fades, dissolves, superimposition and substitution all add a professional touch when properly used.

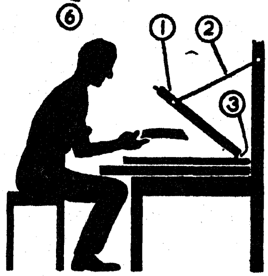
Time can often be saved by using continuous animation, moving the object by invisible wires operated by an assistant. Clockwork toys are another possibility. Toys or dolls that need single frame animation in long shot can sometimes be animated continuously by an assistant in closer shots where the whole of the object is not visible.

Success in animation cannot be expected first time. The soundest procedure for the beginner is to take short sequences and wait for them to come back from processing before making any more.

Animation requires careful planning and infinite pains, but given certain basic equipment it is not difficult, and results are very rewarding. Accurate alignment of camera and subject, and ability to remove and replace both in exact register, are important. *Right:* A rostrum is essential, and it must be accurately calibrated to the camera. 1. Single frame unit. 2. Camera. 3. Release cord. 4. Lamps in reflector. 5. Glass sheet for holding drawing flat. 6. Baseboard. 7. Drawings held in place by two registration pins.



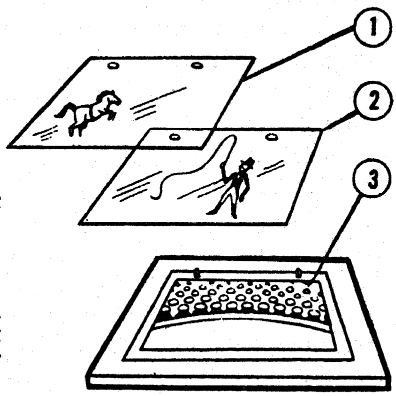




Left: Sheets of celluloid or "cells" should be punched in two places and fitted on register pins. To prevent tearing, and as an aid to removal, place a metal plate over the holes and underneath the cell.

Right: To keep the drawings flat use a sheet of glass in a wooden frame (1), hinged at the back (3), with an elastic (2) to hold it up while the drawings are changed.

An animated subject is broken down into elements according to the amount and frequency of movement. The circus horse (1) is the principal moving object involving the most frequent change of cells, which are therefore placed uppermost. The ringmaster (2) will crack his whip from time to time but not move much otherwise; so his cells come next. In a simple film the audience may not move at all. So they and the circus ring can be drawn on card and remain unaltered (3).



Invisible Wires

Objects can be animated without the use of single frame shooting, if black thread or wire, carefully concealed against a dark background, is used to provide movement. Thus a bottle might move away mysteriously as the thirsty man reaches for it. When he then tries to pick up a glass of water, a nylon thread can be made to pull it away from him. On trying to get away from the haunted locality, he could reach for his hat, which might likewise disappear in magical fashion.

Cartoons

The complication of cartoon making (apart from any drawing ability needed) is that many guide sheets have to be prepared. We are dealing not merely with a simple change in *length* as in a graph, but the drawn objects are changing their *shapes* all the time. So the guide sheets have more in them than a single line.

The main guide lines will show two limiting positions for each movement and the intermediate positions can be worked out from them by simple division.

The cheapest medium on which to draw is paper. The first rule is to make the drawings simple, whether in colour or black-and-white. Do not be afraid of being too elementary. The creation of pin-men antics can provide an enormous amount of fun, for it is the action that matters, not the primitive characters.

To save having to draw a background scene on every sheet of paper, you can economize on drawing time (though not on expense) by making one background sheet. The animated characters are then drawn on celluloid sheets through which the background will be visible all the time.

The sheets of celluloid, or *cels*, must be numbered in series and have a pair of registration holes punched along the top edge. The holes fit over corresponding registration pins on the animation desk, or *rostrum*. The pins are matched by corresponding pins on the camera titler, if this is separate from the rostrum. When all cels are in position for a take, reading from bottom to top we have (*a*) the background, which may be a

plain surface, (*b*) the parts of the subject which do not move, and (*c*) the parts to be animated. Animation is obtained by changing the top set of cels one after another and exposing a single frame for each.

Not all cartoons are made on a special bench or even a titler. There is table-top animation performed by solid puppets in three-dimensional sets. This arrangement suits colour-filming admirably.

Again simplicity can be effective. Animating a nursery toy to react to some antic of the baby is certain of a laugh. The toy must be jointed or flexible so that it will stay in whatever position you put it. You move his arm or head or ears a bit at a time for each frame exposed. Allow enough film before and after the movement to let the audience see the effect.

Advanced Techniques

THE 16 MM. GAUGE, introduced originally for purely amateur purposes, has now also been widely adopted by professional film makers in the fields of industry, medicine, education and publicity. A film can record a complete manufacturing process, or the detailed working of a single machine, a scientific experiment, or a surgical operation.

In the course of such productions special cinematographic processes and techniques are occasionally employed. Although they may largely be beyond the range of normal amateur work, they are nevertheless of sufficient interest to deserve some mention here.

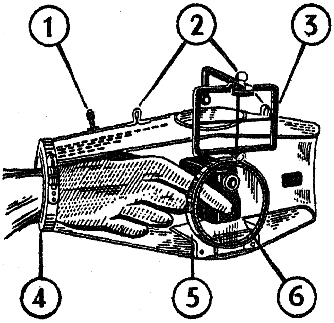
Under-Water Cinematography

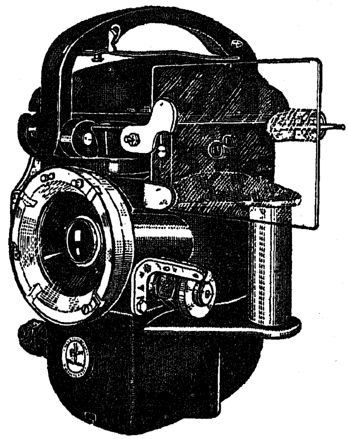
The popularity of frogmen outfits for skin diving, and the availability of waterproof cases for cine cameras, make filming under water a practical proposition for anyone with the means to buy the special equipment.

The diving outfit is in this case at least as important as the photographic gear, and must be of the best quality. The necessary items are a good diving mask with breathing tube, and flippers. For deeper water an aqualung or similar equipment is useful. Equally essential is thorough physical fitness of the diver.

As there is no standardization in the position of the controls of various cameras, there can also be no universal under-water case. Each one is designed to fit a particular camera.

The best type of under-water camera case is made of non-corrosive metal, with glass windows. There is usually provision

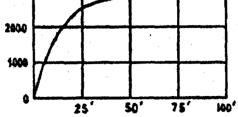


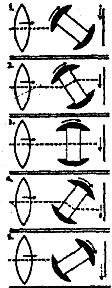


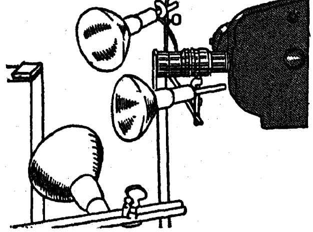
With a frogman outfit and waterproof camera case, all that is needed for underwater filming is fine weather and clear water. *Left:* Plastic case accommodating camera and operator's hand. 1. Water seal. 2. Carrying strap loops. 3. Inflation valve. 4. Wrist strap. 5. Adjustable camera platform. 6. Lens port. *Right:* Metal case with main controls extended to operate from outside. As cameras differ greatly in external design, metal cases are designed for particular models. They should be used in preference to other types, especially in deeper water.

Below, centre: High-speed cinematography utilizes special cameras operating at over 1,000 f.p.s. The film moves continuously through the gate, and the image is optically deflected to follow the film. 1. Beam from lens interrupted by shutter rotating clockwise. 2. Beam deflected upwards to advancing film. 3. Beam undeflected. 4. Beam deflected downwards. 5. Beam interrupted. Very powerful illumination is required.

Below: A high-speed camera requires about 50 ft. of film to reach an operating speed of 3,000 f.p.s. In this graph speed is plotted against footage.







for pumping air inside, both to test its watertight properties and to balance the outside water pressure, which increases greatly with the depth. Cases are also made in the form of a soft plastic glove, into which the camera is inserted, together with the hand, but these are less reliable as water can still find its way in.

Under-water filming is only possible at short distances, therefore a wide angle lens or attachment is advised, to cover the maximum possible field of view.

When lighting conditions permit (see below) it is advisable to run the camera slightly faster than normal, in order to slow down the movement of fish and swimmers, otherwise these subjects will pass too rapidly out of view. If the projection speed is 16 f.p.s., the taking speed should be increased to 20 or 24 f.p.s.

The most interesting under-water effects are obtained with colour film, though its slow speed is a handicap. In this connexion, it is important to remember that as the depth increases the rays at the red end of the spectrum are progressively reduced. At 3 feet below the surface the red is reduced by 50 degrees; at 15 feet it is entirely eliminated. At 30 feet all orange is absent and at 60–70 feet all yellow and violet as well. At 100 feet everything looks blue-grey.

Professional under-water cinematographers have developed special lighting units fitted with 1,000 watt projection lamps and batteries for operating at great depths.

Exposure

In British waters, suggested lens aperture settings when using a medium speed black-and-white film in bright sunlight at depths down to about 20 feet are between *f*2 and *f*4. Below 20 feet the light falls off rapidly and it is impossible to work at all without special lighting.

Mediterranean waters provide ideal conditions for under-water filming. In summer on a bright day with calm sea, shooting should be possible between 9 a.m. and 7 p.m. The lens aperture depends on the working depth and the nature of the sea bottom.

UNDERWATER EXPOSURES

Conditions	*Depth*	*Camera Speed*	*Aperture with*		
			Daylight Colour Film 21–22°	*Medium Speed Pan Film* 28–30°	*High Speed Pan Film* 33–34°
Shallow water, sandy bottom	2–3 ft.	20–24 f.p.s.	*f*2.8–3.5	*f*5.6–8	*f*11–16
Shallow water seaweed covered bottom	2–3 ft.	20–24 f.p.s.	*f*1.5–1.9	*f*2.8–4	*f*5.6–8
Deeper water	20 ft.	16 f.p.s.	*f*1.5	*f*2–2.8	*f*4–5.6

These values apply to the Mediterranean on bright, sunny summer days.

The Dive

The length of the dive will, of course, depend on the diver's outfit.

If carrying air bottles, the cameraman can choose his angles and his lighting at leisure. With a diving mask only, a diver can remain down for about half a minute, leaving about 10 seconds for the actual shooting. In this case, one or at the most two, separate shots can be exposed before the diver has to return to the surface.

No attempt should be made to remain still in the water; the act of swimming produces a natural "tracking" movement which, as the under-water experts of the professional cinema have shown, is very appropriate to the subject.

The unusual nature of under-water technique should not lead the movie-maker to neglect the ordinary rules of film making.

Variety and change of angle are just as necessary here as in routine work.

Do not therefore confine shooting to the under-water regions. Film the boat leaving harbour, the swimmers entering the water, the loading of the harpoon, a big close-up of the fisherman's finger on the trigger, and the harpoon darting towards its target. The under-water sequences can then be cut into these other shots, and the film will tell a coherent story of the whole expedition.

Close-up filming of small objects which then appear larger than life on the normal projection screen can be undertaken with almost any camera.

For working distances of between about 10 and 15 inches a practical method is to mark out the subject area with a wire frame, and fasten this rigidly to the camera. If the focusing range of the lens is insufficient, a supplementary lens can be used. Some titling devices can also be used for close-ups in this manner by removing the title card and leaving an open frame in the subject position.

This method enables the camera to be moved while shooting, as may be necessary when following the movements of an insect. But as depth of field is greatly reduced at these close distances, a small lens aperture may be needed; and this in its turn will only be possible with bright lighting and/or fast film.

As in titling (page 158) close-up apparatus of this kind needs careful calibration. A special clearly marked card should therefore be placed in the subject position and filmed. The results should then be checked by projection.

With the foregoing method, the camera can only be used at a fixed subject distance. When the subject distance varies from shot to shot, and in particular when it is desired to bring the camera even closer, extension tubes are required between the lens and its mount. Some form of gate focusing device (page 148) or a camera with continuous reflex finder (page 150) then becomes essential.

With the standard camera lens it will probably be found that the apparatus has to be placed inconveniently close to the subject. It is therefore advisable to use a telephoto lens, e.g. 1½ inch (36 mm.) for 8 mm. cameras, and 3 inch (75 mm.) for 16 mm. equipment.

When extension tubes are used, the effective lens aperture is reduced. The new value can be calculated from the scale of reproduction (page 147).

It is often advisable to run the camera faster, e.g. at 24 or 32 f.p.s., to slow down subject movement, particularly in the case of insects and flowers.

Aiming the Camera

With such very small subjects, correct aiming becomes very important. A fraction of an inch one way or another may make the difference between success and failure.

Rather than take the camera out into the field in search of subjects, it is therefore better to construct a portable specimen stage at a fixed distance from the camera and carefully calibrated to it. Thus the subject can be brought to the camera.

The specimen stage can have a cork base, so that specimens can be pinned or stuck in position with thread or cellulose tape, and leaves or other greenery used to hide these artificial aids.

Cinemicrography

Cinemicrography is a specialized field with many applications in industry, research and medicine. It is not, however, beyond the scope of an enterprising amateur who is already familiar with the workings of a microscope. And that is half the battle.

While a versatile camera is undoubtedly easier to adapt for the purpose, simple apparatus can also be used. Those accustomed to laboratory work are in any case usually skilled at improvisation. A start can be made by simply positioning the camera so that the lens fits close to the microscope eyepiece, without any optical or mechanical connexion between the two instruments. Obviously an essential requirement is a rigid mount for the camera, where it can be removed and replaced without the need for resetting.

The camera should preferably be fitted with a reflex viewfinder for accurate centring of the image. An alternative is to use a binocular microscope, line up the camera carefully to one eyepiece and observe the specimen in the other.

Adjustment is much simplified if the microscope itself is designed for motion picture work. In this case, the specimen is observed by means of a lens placed between the camera taking lens and the microscope eyepiece. This special finder contains a silvered prism which allows about 75 per cent of the light to pass directly through to the camera, the remainder being used to reflect the image to the cameraman. Thus the specimen can

be observed while the camera is running. In some cases the prism swings out of the light path when required, enabling the full illumination to be used for the exposure.

Normal degrees of magnification in this work are in the region of 100 to 200 diameters. Depth of field is virtually non-existent, and the very slightest movement of the microscope towards or away from the specimen will throw the image right out of focus.

Illumination

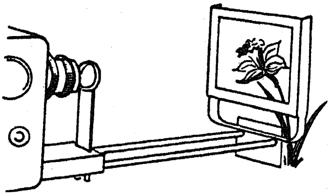
Artificial light is essential, daylight being too unreliable. Illumination is usually provided by a low voltage lamp concentrated on the specimen, diffused light being of insufficient intensity. A glass tank is sometimes necessary for cooling purposes.

To obtain sufficient image contrast with black-and-white film, and to correct colour rendering with colour film, filters may be necessary. The colour rendering is also affected if the lamp is overrun. In specialized work of this kind, experiment is the rule, both as regards contrast, colour rendering and exposure.

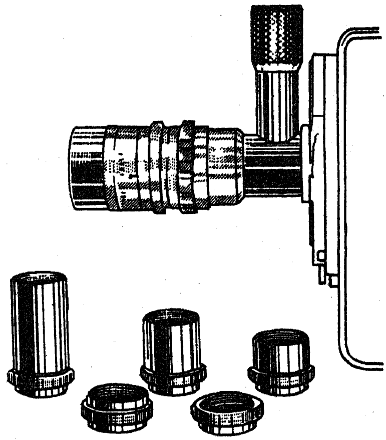
Trial and error is the only possible way of ascertaining the correct aperture. This will depend on the colour and opacity of the specimen, the nature and intensity of the light source, the degree of magnification, the microscope aperture, and the speed of the film.

A photo-electric exposure meter can be experimentally calibrated for cinemicrography by holding the cell close to the microscope eyepiece. The intensity of the light is then varied by adjusting a rheostat, the meter reading noted and a test exposure made. In this way it is possible to establish a direct relationship between the meter reading and the actual exposure required in the particular circumstances.

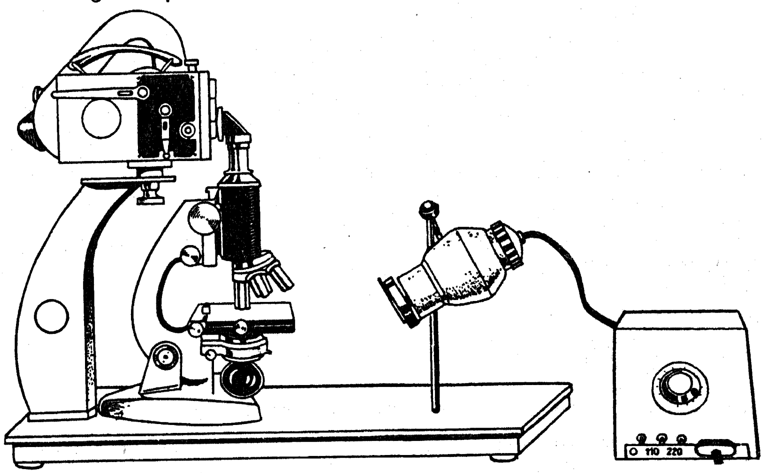
Where camera and microscope are used in conjunction, the camera lens no longer functions as a separate optical unit. The iris diaphragm of the camera does not control the brightness of the image, which remains constant at all apertures. When the iris is closed, it produces vignetting.



Above: Some titlers can be used as close-up framing devices for small objects such as flowers and insects.



Above right: For extreme close-up work the lens can be brought into sharp focus by inserting extension rings or tubes between it and the camera. The longer the extension, the closer objects can be focused. Focusing and centering are extremely critical at close distances, and the extension tube fitted to the camera in the illustration has a reflex focusing device for this purpose. The use of extension tubes reduces the effective lens aperture, and this must be allowed for when calculating the exposure.



Typical set-up for cinemicrography, using a 16 mm. camera. The camera is coupled to the microscope eyepiece by a reflecting prism. The lighting unit and transformer are on the right. The camera shown here has a reflex finder which enables the image to be centred, focused and continuously examined.

With cameras not so fitted other means of viewing are required, e.g. through one eyepiece of a binocular microscope, or by special reflex attachment between microscope and camera.

High-Speed Cinematography

In industrial and scientific work there are many phenomena that can only be observed by recording them on a cine camera running at high speed, and projecting the film at normal speed. Amateur cameras will not normally run faster than 64 f.p.s., but for special purposes, cameras are available that record several thousand frames in a single second.

For speeds up to about 200 f.p.s. the normal type of intermittent drive, in which the film remains stationary in the camera gate for a fraction of a second, can be used. This speed gives an 8 times reduction in subject movement if the film is projected at 24 f.p.s.

For still higher speeds the intermittent drive is not suitable. Instead, the film runs continuously and the image is momentarily brought to rest by optical compensation. This is achieved by means of a rotary mirror, lens or prism, and such a system enables as many as 8,000 frames to be exposed per second on 16 mm. film. The upper limit is set by the maximum speed of film transport and here the limiting factor is the strength of the film itself. One well-known high-speed 16 mm. camera is designed to operate at speeds between 1,000 and 3,200 f.p.s.

At such high speeds the process or movement must be most carefully timed, as a 100 foot reel of film runs through the camera in little more than 1 second at the rate of 3,000 frames. This speed is not obtained instantaneously; the camera uses the first 50 feet in acceleration, and maintains the rated speed for the remaining 50 feet. The projection time of the latter half of the film is then about 2 minutes at 16 frames.

High-Speed Lighting

Illumination for high-speed cinematography can be supplied either by a continuous light source or by a high-speed flash.

Two overrun photospot lamps will produce a light intensity of 65,000 foot-candles on an area 4 × 4 inches at a distance of 18 inches. They are intended for intermittent burning with operating periods of 15 or 20 seconds at full power. These lamps are particularly suitable for small areas.

A high speed flash, now being used in laboratories and research establishments, uses two special compact-source mercury-cadmium lamps which operate normally at 1,000 watts. They are designed with special electrodes and seals to enable them to withstand a heavy overload for a short period. They may be run at 3 kilowatts for 5 seconds, 5 kilowatts for 2 seconds or at 10 kilowatts for 1 second, thus providing sufficient light for high-speed colour photography at speeds up to as high as 3,000 pictures per second.

For work at extreme speeds, a cine *camera* is not used at all. The high-speed flash provides a set of still pictures—sometimes as few as twenty—and these can then be reproduced on motion-picture film and analysed in a projector.

Editing

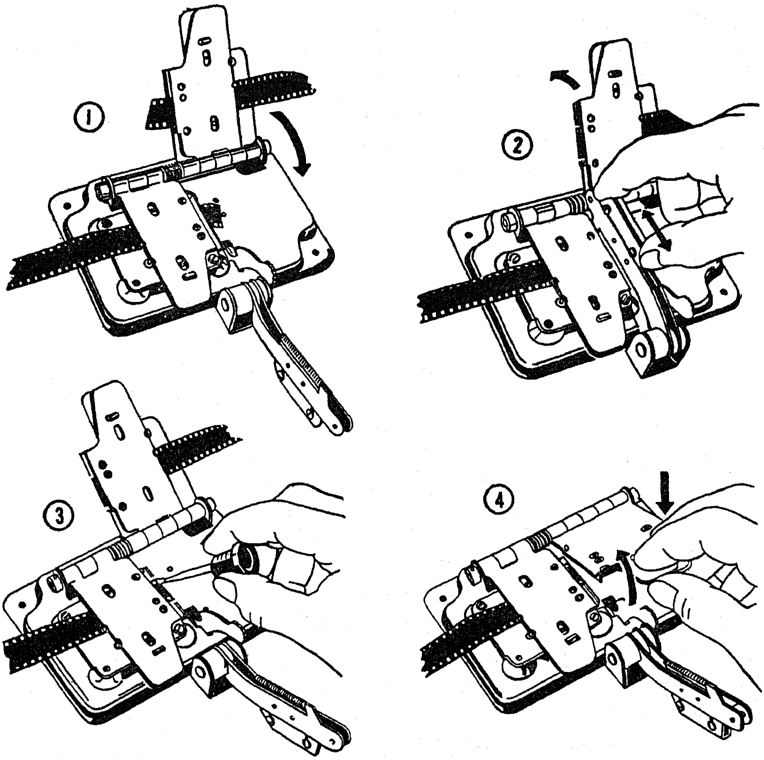
MOVIE-MAKING does not end when a reel of film comes back from the processing station. You will naturally want to project the results at once; but do not imagine that you now have a finished film. In the professional cinema the director sees rushes of the previous day's shooting; they are hurriedly assembled for screening, but are nothing more than the raw material from which the finished film is made up. Your newly-processed reels are like these rushes, and equally incomplete. To make a coherent film out of them they will need editing.

A certain amount of equipment can be considered the absolute minimum, even if you intend to go no further than removing unsuccessful shots from a reel. The essential items are a splicer, a bottle of film cement, a rewinder, and a magnifier or animated viewer.

Splicers

In all three gauges there is a wide variety of suitable splicers on the market. Prices vary a great deal, but an expensive one is not necessarily more efficient than a cheap one. It may do the job quicker though. A cheap splicer of reputable make is perfectly satisfactory for occasional use. Certain splicers are suitable for two or even all three film gauges.

The actual manipulation of a splicer varies according to the model, but the principle throughout is the same. Both ends of a proposed splice are cut so that there is sufficient overlap covering one perforation hole. The pieces thus trimmed are placed emulsion upwards in the splicer. Emulsion is then removed from the splicing area of the end which is to come



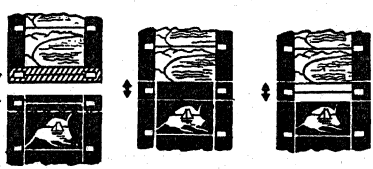
1. Fit the two ends of film to be joined on the registration pins and clamp them in position on the pressure plates. The emulsion of the left-hand end must be uppermost. With the right hand plate raised as shown here, the emulsion of the other end faces away from the operator. Trim the ends by swinging the right hand plate down.

2. Raise the right-hand plate, bring the scraper into position and remove the emulsion from the exposed strip of the left-hand end. After scraping, brush emulsion particles away.

3. Apply film cement.

4. Lower the right-hand pressure plate, bringing the two films together, and clamp it in position.

When joining two scenes of different density, scrape the emulsion from the *lighter* of the two frames (*left*). This will leave the darker end untouched, and the splice (*centre*) will pass unnoticed. If you scrape the *darker* frame an unpleasant light flash results (*right*).



underneath. A thin layer of film cement is applied to the bare film at this point, the other end of film placed above it, pressure applied for 15 to 20 seconds, and the joint is made.

Most splicers are designed to cut both ends to the requisite length automatically. More elaborate models also have a built-in scraper, carefully adjusted to remove only the emulsion from the film without touching the base. Simpler models have a separate scraper, which must be manipulated with due care.

Splicing Points

As an ordinary splice on any of the three amateur film gauges inevitably encroaches on the frame area, special care is needed to ensure that it is not too disturbing on the screen. If scraping is too vigorous, or extends beyond the essential minimum area of overlap, the result is a white flash on the screen which is most disturbing.

The same undesirable effect results from over-liberal application of film cement, which dissolves the emulsion adjacent to the splice and within the frame area.

When editing reversal or positive film, and splicing shots of different densities together, always make a point of scraping the lighter of the two images. This will ensure that the splicing area visible on the screen is dark rather than light, and will make it less noticeable. This may involve a change in splicing routine; if you have to take the ends of film round the other way into the splicer, which is always designed to scrape one side only—usually that on the operator's left.

When splicing negative 16 mm. film, the requirements are just the opposite. The splice should be light rather than dark, so as to appear dark rather than light in the print.

Special negative splicers, providing an overlap of only 1/32 in. and thus a minimum of encroachment into the picture area, are designed for 16 mm. film. They can also be used on 8 mm. films.

Always purchase film cement in small quantities. It deteriorates during storage, whether or not the bottle is used. Make sure you get the right type for the film base you are using. Apply cement very sparingly with small brush, glass rod, or matchstick.

Rewinders

Rewinders are available with either one or both ends geared. For routine rewinding after projection one geared end is enough, but for editing purposes the additional geared end is a great convenience.

Rewinders are available either separately, or mounted in pairs at the ends of a long board. The latter may accommodate also the splicer, and an animated viewer or magnifier. Make sure that the shafts of the rewinders are mounted high enough from the baseboard to take the largest reels that you intend to use. Standard size reels are those accepting 200 feet of 8 mm. and 400 feet of 9.5 or 16 mm. film.

Magnifiers and Animated Viewers

Proper editing is impossible without adequate means of enlarging the individual frames of the film.

The 9.5 and 16 mm. gauges of film can be handled fairly satisfactorily with the aid of an ordinary magnifier over a sheet of ground glass illuminated from below. This is, however, hardly practicable with the 8 mm. gauge where the frame is so small.

For serious editing in any gauge, an animated viewer is indispensable. This device, which incorporates a rotating prism, enables the picture to be viewed on a ground glass screen measuring between $1 \times 1\frac{1}{2}$ inches and $3\frac{1}{2} \times 4\frac{1}{2}$ inches, according to the model. When the film is pulled through the viewer the prism takes the place of the shutter and intermittent movement in the camera, and reproduces the action in the film in a fairly natural manner on the ground glass screen. This enables the editor to determine the exact frame at which a particular shot should begin or end.

Several models of animated viewer are fitted with a special notching device enabling frames to be marked for identification.

Handling, Sorting and Storing

The principal enemies of the film editor are dust, and particles of emulsion removed by the scraper. After scraping the emulsion, dust over the splicing area with a camel-hair brush.

If working with bare hands, only hold the film by the edges. Otherwise wear cotton gloves.

The final order of shots in an edited film is usually quite different from that in which they were actually filmed. A writer revising his manuscript has only words and pieces of paper to sort; a film editor's material is much more awkward to handle. A short film may contain fifty to sixty separate shots, each perhaps three or four feet long. Sorting out, and individual storage during the working period, which may extend over days or weeks if you are otherwise engaged, can be a considerable problem.

It is a simple matter to construct a rack, or a box with a set of numbered compartments, for holding short lengths of film prior to their rearrangement in final screening order.

A row of gramophone needles hammered into a board will make a suitable rack and the individual shots are suspended on the needles by the perforation holes. Clothes pegs can also be used in the same way. The needles or pegs are then numbered and an index kept on a piece of paper or in a notebook.

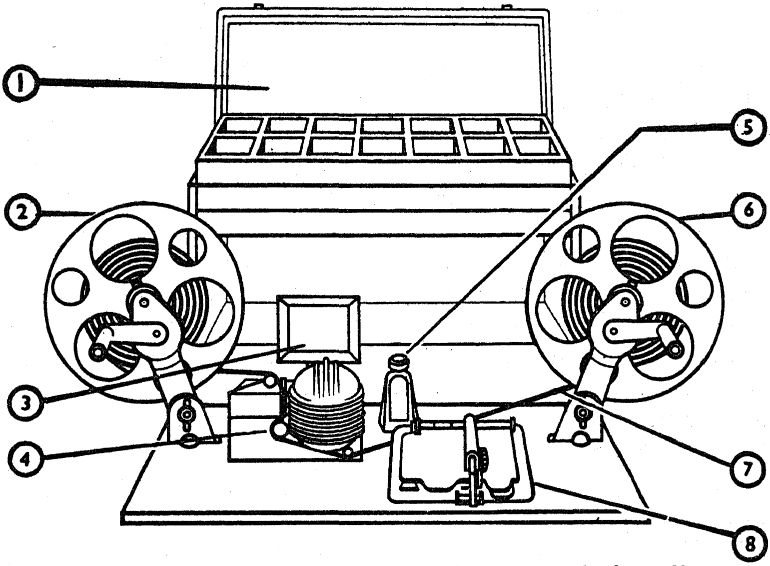
Such a system does not however lend itself to overnight storage, ~~unless~~ the racks are suspended over fibre or metal bins, as in professional cutting rooms, ~~which can be~~ closed when desired. For work on a small scale, editing boxes provide for both sorting and overnight storage. There are several types on the market, some forming part of a complete editing outfit including an animated viewer.

A number of pill-boxes stuck to a sheet of plywood or hardboard can serve the same purpose.

Measuring Running Time

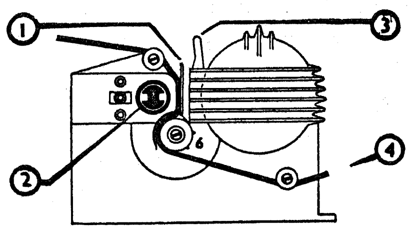
In the final stages of editing it is important to know exactly how long each shot will appear on the screen.

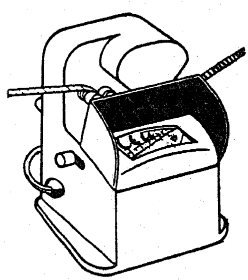
Duration depends of course on footage, and a footage counter will give the answer at once. But footage counters (available for 16 mm.) are expensive items. It is easy to mark out a special ruler in seconds of running time by laying the strip of film along a piece of wood and marking off the frames, or individual pictures, in multiples of 16 and 24. The 16 frame markings will



The editing table contains all the equipment for editing and splicing films.

The spool of film (2) is threaded through the animated viewer. The frames are enlarged on to a miniature screen (3) as the film passes through the gate (4). Individual shots are then indexed and can be kept in the pigeon-holes (1). They are reassembled in the desired order by cement (5) and splicer (8) and wound (7) on to the take-up spool (6). The edited film is then wound back on to the feed spool (2) and is ready for projection.





An animated viewer is a miniature projector incorporating a separate (*left*) or built-in (*right*) screen. Film transport is continuous and successive images are projected through a rotating prism. The model illustrated on the *left* incorporates a gate with pressure pad (1) and optical shutter system (2). A notching device (3) is provided to enable the operator to mark any desired cutting point on the film. The film is fed from one reel at (4) and passes over the sprocket (6) which drives the shutter system.

indicate seconds of running time for the normal silent speed; the 24 frame marks, specially valuable for 16 mm. film, indicate seconds of running time at the normal sound speed.

In this connexion it is worth remembering that most library copies, originally made from sound film, should be projected at 24 f.p.s. as they were originally exposed, even if they are silent prints.

A reasonable length of ruler for 8 mm. film, giving 8 seconds running time at a stretch at silent speed of 16 frames, need be no longer than 1 foot 8 inches. For the larger two gauges a length of 3 feet will be required to measure 5 seconds running time at sound speed, or just under 8 seconds at silent speed. The ruler is used just like that employed by an assistant in a draper's shop when he measures out cloth. Although rough and ready, this method enables individual shots to be measured for running time more rapidly than with an expensive geared frame counter.

Getting Started

When a reel of film comes back from the laboratory, the first step is to run it through on a projector or animated viewer and make a note of all the shots that are obviously useless, either by reason of exposure error, camera shake or fogging. After removing these shots, splice the remainder together again, then project or view the film once more and make a list of shots as you go along. The list can have four vertical columns, headed as follows:

1. Original order as exposed.
2. Proposed screening order.
3. Scene description.
4. Notes.

Column 2 will, of course, remain blank until the final order is settled. In column 4 note down points to assist in deciding whether, and if so where, to use the shot. Such points are:

Duration (*or number of frames*).
Duration of shot (*if any*) before *relevant action begins.*
Image size (*e.g. L.S., M.S., C.U.*).

Tone and (with colour film) colour value. (Helpful for matching of shots to be screened in sequence.)
Direction of movement within the frame.
Duplication (if any) between shots.

In this process of sorting and listing, you will have become more familiar with the material and will probably be able to eliminate more shots which appear to be below standard.

The moment has now come to cut up the reel into separate shots, prior to rearrangement in final screening order.

Creative Editing

Editing is not just a tedious chore: it can be creative, too.

Editing can mean tidying up a film and cutting out the failures; or it can be something more—the last creative stage in film-making, following scripting, direction and shooting.

How can the term "creative" be applied to a process which consists merely in joining a lot of shots together in a particular order? The reason is that the significance of many of these shots may vary according to the context in which they are shown. In other words, the act of splicing them together in a particular order may create in the spectator a particular impression not inherent in the isolated shots.

Professionals Show the Way

We can learn much from the methods of the masters of professional editing technique. The Russian director Pudovkin carried out a striking experiment by putting together shots which were actually quite unrelated.

He took close-ups of an actor whose expression was neutral, then joined them successively to shots of a plate of soup; of a dead woman lying in a coffin; and of a girl at play. An audience which had not been let into the secret was impressed by the heavy pensiveness of the actor's mood over the soup; was moved by his deep sorrow as he looked at the dead woman; and admired the happy smile with which he observed the girl at play. Yet in all cases the face was the same! Pudovkin called editing "the creative force of filmic reality". "Nature," he

added, "provides only the raw material with which it works." He was writing in the heyday of the silent film, and though he seems to us today to have been overstating the case, the experiment described above does show what editing can do.

What the Amateur can Do

Reduced to the homely terms of everyday amateur filming, Pudovkin's thesis is that individual shots can be made to acquire greater significance through judicious editing. Here is a practical example.

You spend a day at the seaside with friends, and take your camera along. A friend's dog is fond of running into the sea after pebbles thrown for him, and you try to get a shot of the dog poised ready to dart into the surf. When the film comes back from processing, the shot is a failure; all it shows is a long shot of the dog running down the shore and disappearing in the waves.

On a next visit to the seaside in the same company, you get the dog's master to hold a ball up in the air, out of range of the camera, while filming the animal in a close up. During editing the film, you then splice the new shot of the dog in before that of him running into the surf.

This rearrangement of the shots suggests that those of the dog were taken on the same occasion, and that the animal was reacting to a stone in both. In a sense, this may be cheating, but here the end—a convincing portrayal of an incident which actually happened but which you were unable for physical reasons to film on a single occasion—justifies the means.

Incidents of this kind will crop up frequently, and can be handled in the same way provided that there is nothing incompatible in the two shots. Thus the weather must be similar, and no person or feature of the scene should be visible in one shot if its absence in the other would be noticeable and excite comment from the audience.

The procedure described above is exactly that followed in the cutting room in a professional film studio; shots taken "on location" will be spliced into studio shots of details of the same incidents which could not conveniently be filmed outdoors.

Continuity

The main aim in assembling shots should always be to preserve continuity. The example of the dog, given above, shows one way of doing so.

Most family films are shot with little or no advance planning. The result is that a given reel may contain totally unconnected episodes filmed at wide intervals of time. In this case, the editor's task should be to find some central idea or fact to which a number of the episodes can be related and to piece them together into a coherent sequence.

If you are a family man and accumulate a collection of shots of your children of different ages, you can edit the material so as to concentrate attention on one particular child. If, in the course of a holiday, a number of shots are exposed at different times along a particular river or coast, this stretch of water can provide the connecting link. All the shots which feature it can be placed in chronological order, and the remaining, unrelated material, held in reserve or used elsewhere.

When on holiday, the temptation to shoot "off the cuff" is hard to resist. The tendency is to take the camera out when a shot presents itself and put it away afterwards without a thought. In this case maps, plans and tourist brochures can greatly help to bridge awkward gaps in continuity.

Filming Public Events

In the "newsreel" type of film which records an actual event, the editor has not got so much freedom of action. Continuity here is greatly assisted if you have the foresight to get plenty of variety in camera angles, crowd reaction shots, etc. You may of course be lucky and discover ways of putting existing material together in an effective manner, even if there has not been much advance planning.

Opportunities for humorous juxtaposition of different aspects of an event are often only discovered at the cutting stage. While the perspiring participants in a cycle race are battling up a steep hill on a hot afternoon, an enthusiastic supporter with a

glass of beer in his hand may be waving them on from a shady spot. Cross-cutting could be very effective in such cases.

Smooth Cutting

The direct cut, as already mentioned, is the most frequent transition in the cinema. It gives either a fresh view of continuing action, or introduces other action which is presumed to be proceeding simultaneously.

It is the editor's responsibility to ensure that the cuts he makes appear smooth on the screen. At first, this seems paradoxical, for how can what is in fact an abrupt change of view ever appear "smooth"? Let us examine this point.

It is normal to begin a sequence in the cinema with a long shot showing a general view of the action and its surroundings. The recognized procedure is then to move progressively closer in each shot until important details are picked out for the audience, who have been prepared for it by the earlier general views. Careful selection of camera position and aim for successive shots should so rivet the audience's attention on the action that they entirely forget the camera and its constant changes of position.

The successive cuts go virtually unnoticed *as such*, and when the audience can forget the camera in this way, we can be certain that the cutting has been well done. To achieve this happy state of affairs, two essential conditions must be fulfilled.

First, the placing and movement of the actors must remain unchanged from one shot to the next. If they do change, they must do so consistently with the positions they would be expected to occupy if they were moving during the time assumed to elapse between shots.

Second, the successive camera positions must *not* lie in a straight line. As the camera moves in closer, each successive shot should be filmed at a different angle, preferably at least 30 and not more than 90 degrees from the line of view in the immediately preceding shot. This may sound more like geometry than cinematography; but it is a fact that shots taken in succession in a straight line and projected in sequence give the impression that the camera leapt forward in a series of jerks

while still running. If they are taken from only a slightly different angle, the transition appears more abrupt than when taken from a quite distinctly different angle. In this case, a *small* change of angle seems in some way to draw attention to the camera.

The pattern: long shot, mid shot, close shot, is not an invariable rule. It is not uncommon for a sequence to begin with a deliberately puzzling close shot of a feature of a whole subject which is then revealed to the eager audience in the director's own good time.

Cutting on Movement

Movement in the subject often makes a direct cut to a fresh angle or different image size essential (otherwise the actors would pass out of frame). At the same time, the fact that movement always attracts the audience's attention helps to provide a smooth transition between shots. If two actors are seen conversing together in close shot, and the story then requires that one should then get up and walk away, a cut will obviously be necessary if the person who moves away is not to disappear from view. The usual practice is to cut from a close shot to a medium or medium long shot, in which the camera embraces the area across which the actor is to move.

When is the right moment to cut? If the preceding action makes it clear to the audience that some movement is imminent, the cut can take place immediately before it begins. Another, and very frequently used, alternative is to cut while the movement is actually taking place. On paper, this may sound as if it would be jerky on the screen. But when properly done this is far from the case. While the audience is preoccupied with the movement, we shift the camera angle or viewpoint in such a way that the change of shot goes virtually unnoticed.

All the foregoing presupposes, of course, that the action in question is not only carefully rehearsed, but repeated a number of times and filmed in duplicate or triplicate from different camera angles, the final result being then determined at the editing stage. Another instance that editing cannot be considered in isolation from the earlier stages of film-making.

Fades and Wipes

The technical aspect of fades and wipes has been discussed on pages 178 and 183. The short point here is: plan them in advance if possible. Both these special effects can also be made at a laboratory on 16 mm. film, at a price.

Tone Balance

When editing material that has been shot at different times and under different lighting conditions, avoid abrupt changes of tone, and in the case of colour film, also variations of colour balance. Where the individual shots are badly matched in this respect the differences will be less noticeable if they can be grouped in order of increasing or decreasing density.

A further problem arises with colour film. An editor always likes to have a scene shot from several different angles, to give him plenty of scope in cutting. But with colour film and modest lighting equipment, every change of angle on an interior scene will call for a change in lighting set-up; this, in turn, will mean a change in colour values. When different angles of the same scene are inter-cut, these colour discrepancies may be disturbing on the screen.

Such discrepancies will pass almost unnoticed if some appropriate *cut-away* material can be inserted (it may have to be shot specially) between the shots whose colour values do not match. Such cut-aways may be inserts, close-up reaction shots of persons not in frame in the adjacent shots, etc.

Cutting Rhythm and Shot Length

There is a natural tendency among amateur movie makers to keep as much as possible of the original footage in the final screen version. Film stock costs good money and everyone takes pride in their work. But this attitude is not conducive to good films. No shot should be retained in a film because of its photographic merit alone. The only justification for retaining a shot is that it advances the story. And as soon as it has served its purpose it should give way to the next shot.

Generally speaking, the more detail there is in a shot, the longer it should remain on the screen. Long shots may therefore require up to 15 seconds of projection time, but close-ups as little as 2 seconds or less.

The length of individual shots also depends on the mood and tempo of the particular sequence. An exciting horse race calls for rapid *cross-cutting* (i.e. alternation between different viewpoints); a lazy summer afternoon at the beach can be handled in a much more leisurely manner.

The Final Touch

When you have spliced the shots of the film together in the final order, the job of editing is still far from finished. On critical assessment some shots will usually prove to be superfluous and merely hold up the action, others can be shortened with profit.

It is always wise to err on the short rather than on the long side in a film. Better that the audience should feel they would like to see more, than that the show should appear to drag half-way through. To eliminate the personal factor, it is a good plan to show the film to an intelligent outsider.

Editing and Commentary

Family, travel and holiday films—and most amateur films come under these headings—are almost invariably accompanied by a commentary from the cameraman-projectionist. This may be impromptu, or prepared and pre-recorded.

Though the whole question of sound films is discussed on pages 260–280, the commentary, whether *viva voce* or reproduced from a recording, can obviously have considerable influence on editing technique. Commentary can be used to bridge gaps in the picture material, and it is a perfectly legitimate use.

Unplanned films often lack essential continuity material, and here commentary is a great help. The danger lies in regarding commentary as a panacea for sloppy continuity, which could have probably been avoided by more careful editing of the material available. Do not allow the addition of commentary to make you careless about editing.

Projection

AT THE BEGINNING of this book (page 11) we used a simplified description of what happens in a cine projector to explain the principle underlying motion pictures.

Each single picture in the strip of film remains stationary in the projector gate for a fraction of a second, a revolving shutter uncovers the light and an image is projected on the screen. The shutter then cuts off the light, the picture is moved on and the cycle is repeated.

Persistence of Vision

Actually, there is more to it than that. The illusion of reality in projection is only complete if the alternating periods of light and dark produced by the action of the projector shutter succeed one another at the rate of not less than about 50 per second. The eye can see 40 interruptions per second, and the image appears to flicker.

In order to satisfy these conditions, the projector shutter has to be designed to interrupt the light at least 48 times per second, irrespective of the number of different frames projected in that period. When the projection rate is 16 f.p.s., each frame should therefore be projected three times before being moved on by the claw, otherwise flicker becomes evident. For this, the shutter has to have three blades. A projector designed to run at 24 f.p.s. only can have a shutter with two blades, each frame being then projected twice only; but a two-bladed shutter gives quite noticeable flicker at 16 f.p.s.

In practice, most sub-standard machines have three-bladed shutters, enabling them to be run over a range of speeds.

Projector Components

The basic components of a silent cine projector can be grouped under four headings: the optical system (mirror, lamp, condenser lenses and projection lens); the motor; the intermittent mechanism (claw, shutter); and the feed and take-up reels and sprockets.

An optical sound projector has additional mechanism designed to scan the sound track after the film has passed through the gate. The film is held against a drum rotating at a constant speed; light from an exciter lamp is focused on the sound track and impinges on a photo-electric cell. The variations in the track are converted into corresponding electrical impulses by the cell, and then amplified for reproduction through the loudspeaker. That part of the projector where the sound is scanned in this manner is commonly known as the sound head.

Many sound projectors are also fitted with a separate sound head for reproducing from magnetic stripe (page 268) and in some cases also for recording purposes. The facilities often include simultaneous recording on two channels, e.g. speech and music.

Most modern 16 mm. sound projectors will also screen silent films at 16 f.p.s.

Multi-Gauge Projectors

Several manufacturers have produced projectors able to screen films of two or three gauges at will. The most usual combination in a dual gauge projector is 8 and 16 mm. When these gauges are combined, a lens suitable for the larger gauge will give a very small picture (at a given projection distance) with 8 mm. film. It is often possible to obtain a special short focus lens for the smaller gauge.

The change-over from one gauge to another is usually made by interchanging parts such as the gate, pressure-plate and feed and take-up sprockets, which are duplicated. One type of dual-gauge projector has twin film channels side by side, so that no interchange of parts is necessary.

Generally speaking, a high-quality projector designed to

project one gauge only will give better results on that gauge than a machine designed for dual or triple gauge projection.

Current Supply

Most projectors marketed in Great Britain are designed to operate on 200–250 volts A.C. Some can also be operated on direct current.

On silent models the motor is often series-wound with variable manual speed control. Sound projectors have either synchronous or induction motors, or are fitted with a governor, so as to ensure a constant speed of 24 f.p.s. for the projection of sound films.

Lamp Voltage

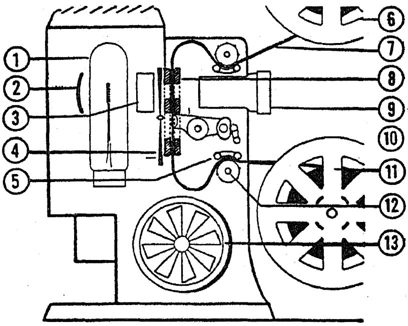
Sub-standard projectors are usually fitted with a powerful tungsten lamp of special type designed for projection.

For maximum efficiency the filament should not be larger than the projector gate. As the size of the filament is in direct ratio to the voltage of the current supply, this requirement is particularly difficult to meet with 8 mm. film. The tendency in modern projectors for this gauge is to use a very low voltage lamp.

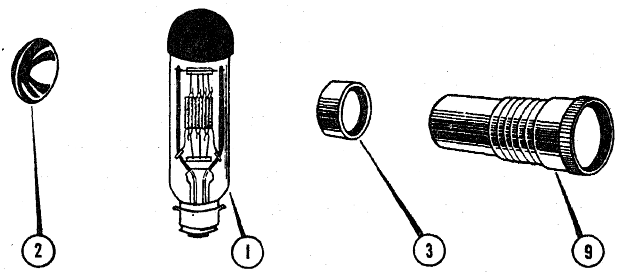
On the other hand, some 16 mm. projectors, formerly fitted with 110 volt lamps operated through an external resistance or transformer so as to obtain a more compact and therefore more efficient filament, now have mains voltage (200–250) lamps which do not require this cumbersome extra component. It is a question of making a compromise one way or another between lamp efficiency and portability.

As transformers only operate on alternating current, certain modern 8 mm. projectors incorporating a transformer to step down the mains voltage for the lamp cannot be used on direct current mains.

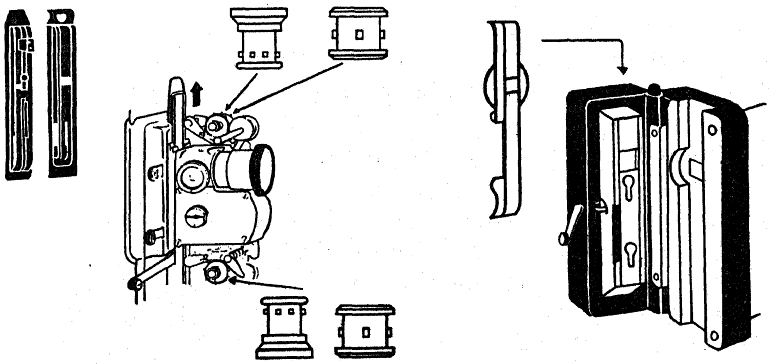
Either type of supply can be reduced by means of a resistance, but a resistance itself consumes current and generates unwanted heat. A transformer is therefore preferable for A.C. mains.



Left and below: Main projector components. 1. Lamp. 2. Concave mirror. 3. Condenser. 4. Shutter. 5. Sprocket wheel roller guides. 6. Feed spool. 7. Film. 8. Film gate. 9. Projection lens. 10. Take-up spool. 11. Film winding on to take-up spool. 12. Take-up sprocket wheel. 13. Motor and cooling fan. 1, 2, 3, 4, 8, and 9 are the optical system of the projector; 5, 6, 10, 12, and 13 are parts of the projector mechanism.



The design of the optical system governs the brilliance of the projected picture. The concave mirror 2 projects an image of the lamp filament into the plane of the filament itself. The condenser concentrates the light on the film in the gate and the projection lens throws the image on the screen.



There are several types of dual-gauge projectors available. The change from one gauge to another is usually effected by interchange of the gate (*above, left,* and *right*) and feed and take-up sprockets (*centre*). When one of the gauges is 8 mm., a special short focus projection lens is desirable.

Lamp Life

It is very important that the rated voltage of the lamp should match the actual mains supply. If the mains voltage is too low, the lamp will burn dimly and emit a yellowish light, which will falsify the rendering of colour film. If, on the other hand, the mains voltage is too high, lamp life will be seriously curtailed. Except when maximum performance is required, it is a good general policy slightly to under-run a lamp.

If the mains voltage is for instance 230, you will get longer life from a lamp rated at 250 volts without much loss of efficiency. Or set a transformer or resistance to step the voltage down rather more than strictly necessary.

Lamp life can be greatly increased if the lamp can always be switched on at low power from cold, and the full voltage only applied when the filament has warmed up.

A rough and ready method of achieving the same end consists in wiring a second projection lamp, or the element of an electric fire, in series with the lamp in the projector. For the actual projection this "ballast" is then short-circuited.

Cooling System

A projection lamp becomes extremely hot, and both for its own protection and that of the film on which the heat is focused, the projector needs an efficient cooling system.

Normally a fan is fitted to the motor spindle, and a forced draught is taken up to the lamp. The cooling system must on no account be obstructed.

Although all sub-standard motion picture film is non-inflammable, it is easily damaged if the film remains stationary in the projector gate while the lamp is switched on, unless there is a heat-absorbing screen between them (see below). It is for this reason that the wiring of all projectors is so arranged that the lamp cannot be switched on when the motor is not running. On the more advanced type of projector, the lamp cannot be switched on until *after* the motor has started running.

Many advanced projectors are fitted with a still picture mechanism, which enables single frames to be examined at

leisure on the screen. The mechanism is so designed that when the film drive is disengaged, a heat-absorbing screen is brought into position between the lamp and the film.

Two other points need mentioning in connexion with ensuring maximum lamp life. The first is that the projector should not be tilted excessively; most projection lamps are intended for burning only in a strictly vertical position. Secondly, never move the projector about while the lamp is burning; the filament is then more sensitive to shocks and vibration.

Lamp Adjustment

Most projection lamps operating at voltages of 110 and upwards are fitted with the so-called P.F. (prefocus) cap. This will only fit into the socket in one particular way, to ensure correct location of the filament.

If the screen image is unevenly illuminated, the lamp may be out of alignment. Most projectors have adjustment for lamp position in both horizontal and vertical planes.

A simple method of checking lamp adjustment is to leave the projector unloaded, place a screen a short distance in front and hold an ordinary hand magnifier in the projector beam. When properly adjusted, this will throw an image of the lamp filament on to the screen. Adjustment is correct when the secondary image of the filament, reflected back from the concave mirror behind the lamp, exactly fills the spaces between the primary image.

It is also possible for condenser lenses and mirror to get out of adjustment, but realignment here should preferably be entrusted to an expert.

The Lens

Just as the focal length of the camera lens (see page 26) determines the field of view that will be recorded on the film, so the focal length of the projection lens determines the size of the screen image obtained at a given projection distance. The shorter the focal length, the larger the screen image at a given distance (depending also on the power of the projector!)

The normal focal length of projection lenses is usually about double that of the standard camera lens of the film gauge in question. Thus 8 mm. projectors have lenses of between 20 and 25 mm. ($\frac{3}{4}$ to 1 inch) in focal length; with 9.5 and 16 mm. projectors focal lengths vary between 35 and 50 mm. ($1\frac{1}{2}$–2 inches). In order to obtain a screen image 4 feet wide from a 16 mm. projector fitted with a 50 mm. lens, the projection distance has to be about 20 feet.

Focusing a projection lens is a simple matter. It is twisted in its mount until the screen image is sharp. Most lens mounts have a coarse and a fine adjustment. The rough setting can usually be found by pushing the lens backwards or forwards bodily against spring pressure, and fine focusing is completed by gently rotating the lens in each direction.

Spool Orientation

The amateur showman who puts on his films the wrong way round is only one degree less laughable than the man who fails to rewind his reels after a show and then finds that they come out backwards and upside down when next screened. A few elementary precautions can easily prevent such mishaps.

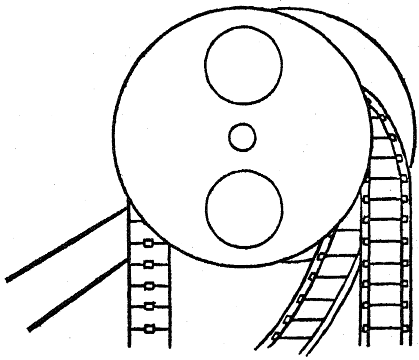
The first essential is to know which way round to hold the film reel before lacing up.

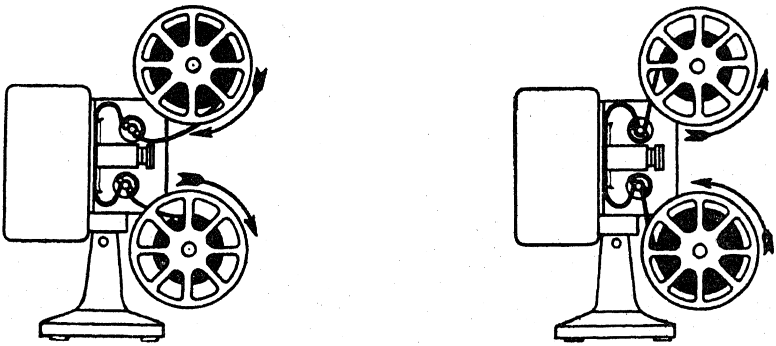
Almost all projectors are loaded and operated ~~on the right-~~ hand side, that is to say the lamp is to ~~the left, the lens~~ and screen to the right of the projectionist. When lacing up a reel of 8 or 16 mm. film, hold the reel up so that the free end hangs down on the right-hand side of the coils.

With the reversal film normally used by amateurs, the emulsion (dull side) will be on the right, and when threaded through the machine it will face the screen. If the projection copy is a positive print from a 16 mm. negative camera original (often used by professionals) the free end should hang down in the same way, but the emulsion will be on the inside of the reel and, when laced up into the projector, face towards the lamp.

With single-perforation 16 mm. sound film, the perforated side must be held towards the operator. Some manufacturers provide spools that will only fit on projector spindles one way

The first step in lacing up is to ensure that the feed spool is correctly orientated. With the projector lens facing right, the free end of 9.5 mm. film should hang down on the left hand side of the spool. The free end of both 8 mm. and 16 mm. film should hang down on the right. With 16 mm. single perforated film and with all 8 mm. film, the perforations must be on the side facing the operator.

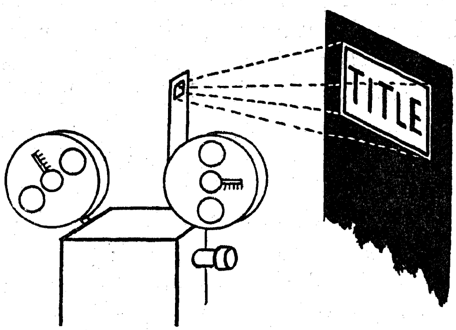




Left: Film path for 8 and 16 mm. projectors. The top (feed) spool revolves anti-clockwise, the bottom (take-up) spool clockwise. On some machines the take-up spool is located at the back. *Right:* Film path for 9.5 projectors.

On some projectors with belt driven spool arms the belts have to be twisted to rotate the spools in the correct direction. It is important to make adequate loops both above and below the gate to allow the intermittent mechanism to function properly.

To test film of any gauge for orientation with the feed spool in position, hold the free end above the spool and stand facing the projector lens and towards the rear of the machine. The image in the film should then appear upright and laterally correct.



round. This is to prevent the film being put on back to front.

Usually 9.5 mm. film is spooled the other way: the reversal (i.e. camera original) emulsion is spooled inwards, and when the reel is held up as described above the free end should drop down on the left-hand side. As the projector of this gauge runs, both feed and take-up spools should revolve anti-clockwise; with 8 and 16 mm., the normal direction is clockwise for both reels.

A minor disadvantage of 16 mm. spools that will only fit a spindle one way round is encountered when using them on rewinders. Some types of animated viewer (see page 223) accept spools the opposite way round to projectors. After editing a film on a viewer, make sure that it is wound back in the correct orientation for use on a projector.

Threading

The exact threading procedure for individual projectors varies according to the design. But certain points are common to all projectors.

When the reel is the right way round, make sure that there is a sufficient length of blank leader: 3 feet for silent projectors and at least 5 feet for sound machines. Make sure also that the take-up spool is at least as large as, or preferably larger than, the feed spool.

When actually lacing up, the most important point to watch is the size of the loops above and below the gate. Both should be large enough to allow the intermittent movement to operate properly without upsetting the regular rotation of the feed and take-up sprockets (and in the case of sound projectors, of the sound drum also). The effect of having the loops too small is immediately apparent on the screen; the image will be unsteady, and there will probably also be an unpleasant noise from the region of the gate. On the other hand, the lower loop should not be too large, or it is likely to chafe against the projector body and damage the film.

Next, make sure that the claw engages properly in the perforations and advances the film smoothly. Most projectors have an inching knob enabling the projector mechanism to be turned by hand for this purpose.

When the moment to switch on arrives, make sure that the lamp switch (if any) is in the "off" position. Do not switch on the lamp until the mechanism has reached normal speed. When the machine has started running, watch and listen carefully for any sign or sound of maladjustment. If anything goes wrong with the threading of a film in a projector running at 24 f.p.s., it is quite possible to ruin as much as 2 feet of film before the machine can be stopped. Although it is a rare occurrence, trouble of this kind usually arises from loss of either loop.

The Screen

A good film deserves a good screen, otherwise all efforts with camera and projector will be wasted. A bed-sheet, on which many a show has been improvised, is simply not good enough. It will inevitably have creases, and in an effort to remove them, other, diagonal, creases will be caused when the corners are stretched apart between drawing-pins. Apart from that, an ordinary sheet absorbs too much light, as can be seen by looking behind it when the projector is directed at it.

The screens available on the market fall into three types: plain white, beaded and silvered. Each has its advantages and disadvantages, and the choice is largely governed by the size of the audience and the shape of the room where the screening is to take place.

The best screen for all-round purposes is probably the beaded type. It gives the most brilliant picture, provided that all the audience can sit reasonably near to a straight line between projector and screen. But if people have to sit at an oblique angle, as would happen in a room which is broader than it is long, image brilliance falls off badly for those at the side, and a silvered screen would be given better over-all viewing quality.

If some members of the audience have to sit very much to the side, the best picture for them will be provided by a matt, white screen surface.

Screens are available in self-erecting (box) form, also with collapsible legs. Sizes vary widely, but a useful size for general home use is about 30 × 40 inches.

Where to Put the Screen

The screen should be placed against a dark background, a pair of curtains for example. If it has to be placed against an article of polished furniture or on a mantelpiece, light-toned furnishings or walls should be covered with some dark material to suppress unwanted reflections.

The illusion of reality in the projected image is sometimes enhanced if the screen can be placed at some distance from background and surroundings. The picture then appears to materialize in mid-air.

Unlike television, films are best viewed under total blackout conditions. The showman's artifice of dimming the lights and bringing them on gently after the programme is by no means to be despised; the result is very restful to the eyes. Variable resistances for the purpose are easily obtainable.

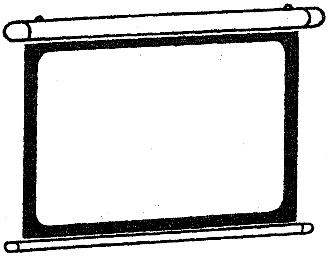
Seating

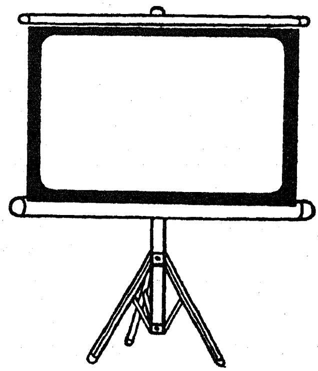
The size of the picture is, of course, governed by the power of the projector, not the dimensions of the screen. But a powerful projector and a large screen do not guarantee good viewing by themselves. Seating arrangements are important too.

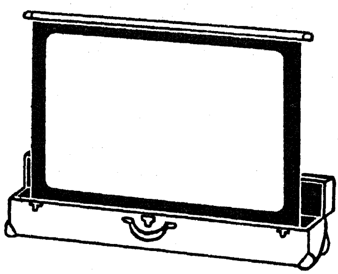
Take care that no one sits too close to the screen. The minimum of comfortable viewing distance will depend on the size of screen; as a general rule it should be about three times the screen width. In any case, it is a mistake to attempt to blow the picture up too big. It then merely looks indistinct and under-exposed. If the back row is placed too far away people sitting there may not be able to see sufficient details. The distance from the screen to the back row should not exceed about eight times the screen width.

With 9.5 and 16 mm. projectors, a projection lamp of 200–300 watts is adequate for a screen $2\frac{1}{2}$–3 feet wide, while a 400–500 watt lamp will be good enough for a screen $3\frac{1}{2}$–4 feet wide. For a larger image, a 750 or 1,000 watt projection lamp is necessary.

For an 8 mm. projector the screen width figures should be halved in each case.

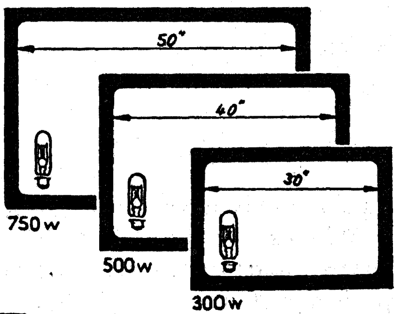


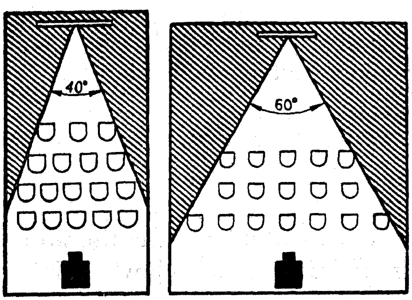




Top left: The conventional hanging screen rolls away into a cylindrical case, which can be fixed permanently above a blackboard in a lecture hall. *Bottom left:* The suitcase type is very compact when closed, but needs a table or other stand when in use. *Top right:* Larger portable models incorporate their own stand.

Right: The power of the projection lamp should match the screen size used. This rough guide applies to 9.5 and 16 mm. projectors with lamps operating at voltages between 110 and 250. With 8 mm. projectors, the screen width obtainable is halved. Some modern projection lamps, operating via transformer or resistance between 6 and 50 volts, are relatively much more efficient than their wattage rating suggests.





Left: The most suitable surface for a screen depends on the angle at which it will be viewed. If all the audience can be seated within an angle of 40 degrees, a beaded surface gives the brightest image. But if the shape of the room dictates a viewing angle of 60 degrees, use a silvered or matt white surface.

The Room

If there is a choice of rooms for screening purposes, a long narrow one is preferable to a short wide one. Two rooms with communicating doors can be turned to good account by placing the projector in one and aiming it through a half-closed door or pair of curtains.

A still better arrangement is to make a false door of hardboard or plywood with a glass projection port at the appropriate height. The ideal is to knock a special projection port in the wall. It can be concealed by a picture when not required.

The purpose of all these arrangements is to isolate the projector from the audience as far as possible. This eliminates mechanical noise, and enables the projectionist to work in proper light.

A silent projector can easily be run without sound insulation, but a sound programme is seriously affected by projector noise. Many modern machines are specially sound-proofed, but it is still better if they can be operated from another room.

Getting Ready

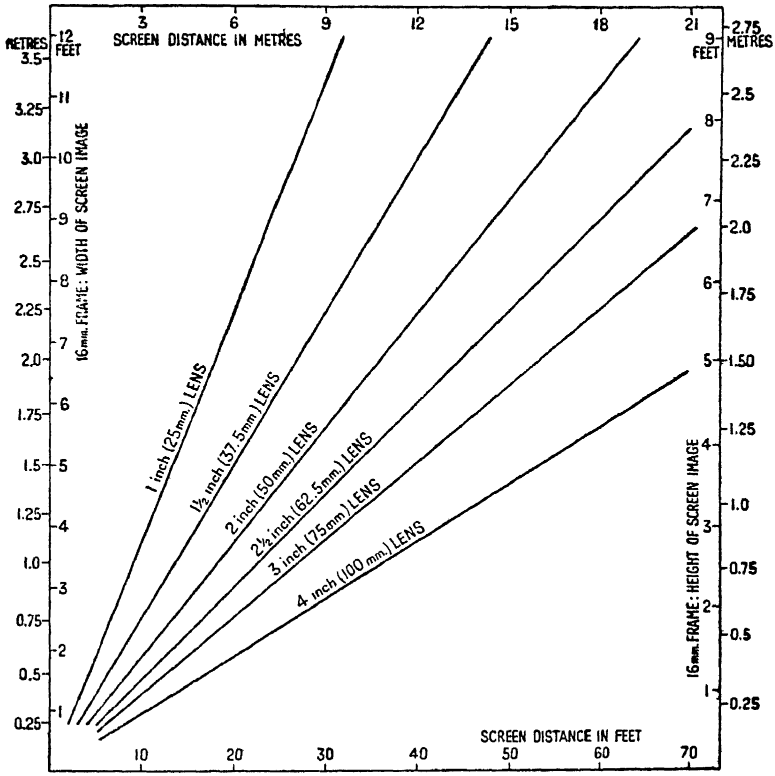
When the projector has been laced up, the tilting and framing controls must be attended to.

The tilting adjustment varies greatly according to the model of projector. Sometimes the whole instrument is jointed in the centre and pivots round a single, large diameter bolt. Or the machine may have four screw feet, each adjustable for height.

When setting up the projector for a show, the main thing to ensure, apart from seating arrangements (see above), is that the projector stands at least as high as the centre of the screen. Attention to this point will often save you the embarrassment of a last-minute search for magazines and books of a particular thickness.

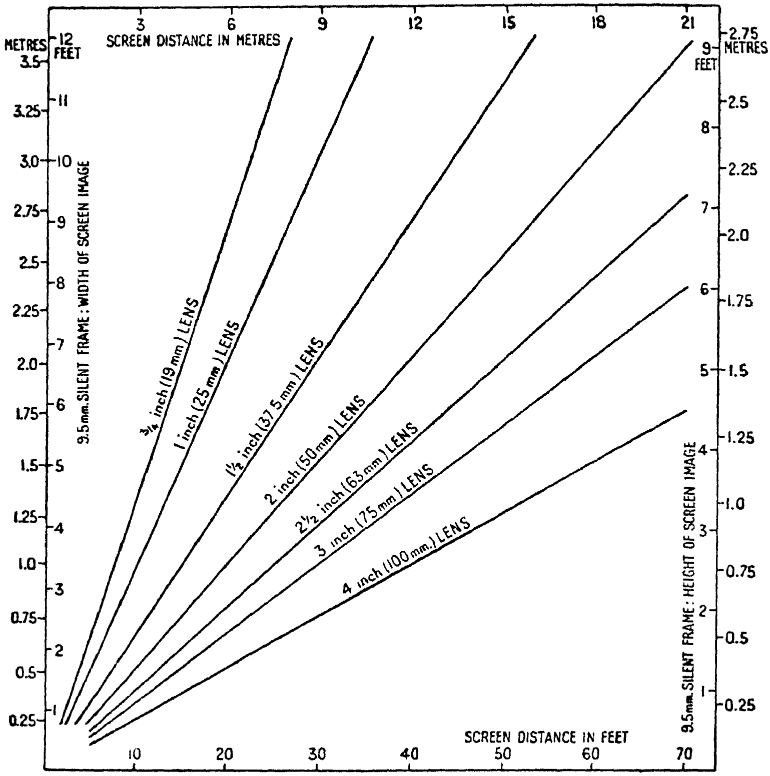
Framing

All projectors are fitted with a control which adjusts the position of the picture aperture in relation to the claw. This is



You are planning a home movie show. Can you fill your screen with the projector at one end of the living-room and the screen at the other? You are showing films in the village hall. Will there be enough room for your audience between screen and projector, or will you need a long-focus lens? The graphs on this and the next two pages will answer these questions.

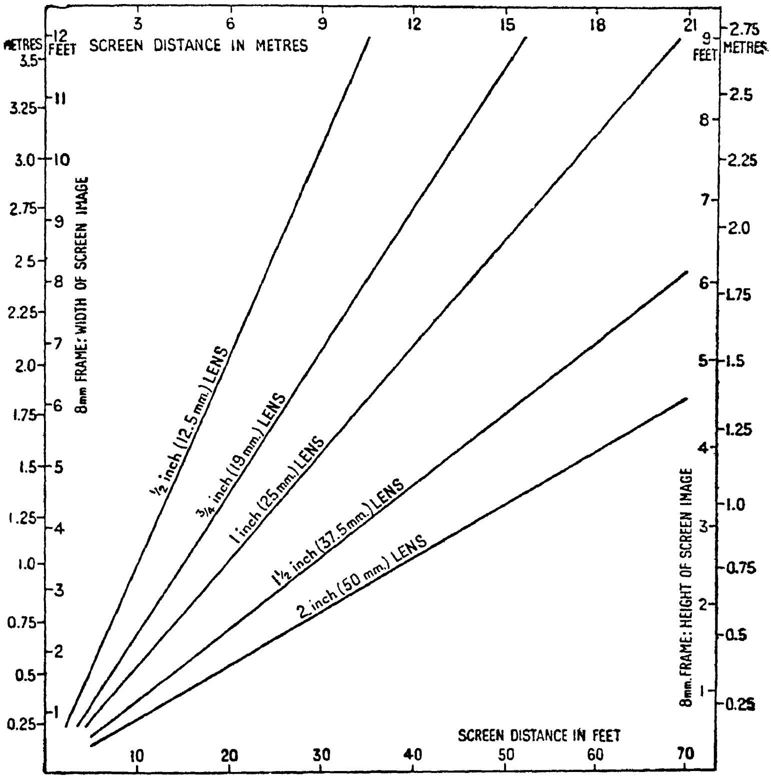
To find the image size at any screen distance, lay a ruler vertically on the page so that it cuts through the screen distance required. Mark the point of intersection, then place the ruler horizontally against the point, and read off the image width on the left-hand margin and height on the right-hand margin. Thus a 2-in. lens on a 16 mm. projector will give a screen image approximately 3¾ × 3 ft. at 20 ft. To calculate the screen distance for any given image size, see page 248.



To find the throw required for any given image size, lay the ruler horizontally across the page, cutting the image width on the left edge. Mark the point at which the ruler intersects the line corresponding to the lens in use, then place the ruler vertically against this point and read off the screen distance along the top or bottom edge.

Example: What throw or screen distance will be needed to fill a 5 ft. screen with a 2-in. lens on a 9.5 mm. silent projector? We lay the ruler horizontally across the 5 ft. mark on the left-hand edge, and note the point at which it cuts the diagonal line corresponding to the 2 in. lens. We now lay the ruler vertically against this point and read off the screen distance in feet along the bottom edge. The answer is 30 ft. To find the image size at any screen distance for 9.5 mm. film, apply the instructions on page 247 to the graph above.

8 mm. PROJECTION SIZES AND DISTANCES



To find the image size at any screen distance with 8 mm. film, apply the instructions on page 247 to the graph above. *Example:* Your projector has a 1 in. lens. If it is placed at 20 ft. from the screen, how wide will the screen have to be? Answer: approximately 1 metre or 40 in. Sometimes the distance between projector and screen, and the width of the latter, cannot be varied. Then we have to find the most suitable focal length of projection lens to fit the circumstances. *Example:* What focal length of lens is needed to fill a 5 ft. screen with 8 mm. film at a projection distance of 30 ft.? Here we go about it the other way round. First measure off the distance of the 30 ft. mark on the bottom edge. Now lay the ruler horizontally across the 5 ft. mark on the left edge. The lens nearest to a point the same distance from the left edge corresponds to a 1 in. lens.

necessary to ensure that the frame is correctly centred in the aperture, and thus fills the screen properly, being neither cut off at the top nor the bottom.

On most models the action of adjusting the framing also moves the picture area up and down on the screen (which in itself affects the tilting, see above). More advanced projectors have optical centring, with which the axis of the lens moves together with the gate aperture. In this way, the picture does not move up or down on the screen, but only within the confines of the screen area.

Attend to all these points before the audience arrives. In winter, make sure that the machine is already at room temperature when the show begins. When a machine is brought in from a cold room or outdoors and operated in a warm atmosphere, condensation will form on the lens and completely spoil the picture until the whole machine is thoroughly warmed up. This may take as long as one whole reel.

Programme Planning

A home-movie session should never err on the long side. Aim at a maximum of an hour and a half. Your family may enjoy watching themselves on the screen; but outsiders will judge the show by stricter standards. Do not overwhelm the audience with your own personal films; introduce some variety by hiring or buying films from the many sub-standard libraries.

SCREENING TIME AND FILM LENGTH

Length of Film (feet)	*8 mm.*	*Time with 9.5 and 16 mm. Silent (16 f.p.s.)*	*9.5 and 16 mm. (Sound (24 f.p.s.)*
25	2 min. 5 sec.	—	—
50	4 min. 10 sec.	2 min. 5 sec.	1 min. 22 sec.
100	8 min. 20 sec.	4 min. 10 sec.	2 min. 45 sec.
200	16 min. 40 sec.	8 min. 20 sec.	5 min. 30 sec.
400	33 min. 20 sec.	16 min. 40 sec.	11 min.
800	—	33 min. 20 sec.	22 min.
1,600	—	66 min. 40 sec.	44 min.

In the professional cinema, not only do the lights dim gently before the show begins, but the audience only sees what it is

meant to see: the censor's certificate at the beginning, and the end titles. Too many home shows begin with several seconds of fogged film with perforated emulsion numbers flashing past. To raise a show to professional standard of presentation, only switch the lamp on when the picture is in the gate; and switch off immediately after the end title fades. If you have no separate lamp switch, interrupt the projector beam with the hand or a piece of black card.

Avoiding Breakdowns

Always be prepared for trouble during a show; you are then unlikely to meet it.

If you are giving a show away from home, make a point of finding where the fuse-box is, and check whether the socket to be used will carry the necessary load. There is such a variety of electric fittings in Great Britain that it is a good idea to keep handy a box of assorted plugs and a screwdriver.

There is a great temptation to use a bayonet adapter for fitting in place of a standard electric light bulb, this being the only fitting which can be plugged in for certain in any household. But with large projectors, it may overload the circuit and blow the fuse; also the mere weight of the projector lead may drag the fitting to the floor and break it; and lastly there is no means of earthing the apparatus.

Other essential equipment for the showman includes a pocket torch (useful whether or not the projector has a pilot lamp); and a reel of cellulose adhesive tape, for use in the event of film breakage. The $\frac{5}{8}$ inch wide variety exactly fits 16 mm. film; 8 mm. film can be joined if desired with the adhesive tape sold for joining $\frac{1}{4}$ inch magnetic tape. When making an emergency join, stick the tape on to the base (i.e. shiny, non-emulsion) side of the film.

Projection lamps have a habit of burning out when least expected. The remedy is obvious: always carry a spare. But let that spare be of at least equal power to the one in the machine. A show that begins with a 500 watt bulb and has to end with a 250 watt lamp because of a breakdown creates a very bad impression.

Rewinding

It is best to leave all rewinding till after the end of the show. Though some projectors are fitted with a power-driven rewind, it is kinder to the film to rewind them by hand.

When projecting a succession of reels and leaving them to accumulate for rewinding later, arrange the order so that you are not left with a take-up reel (from the preceding film) that is too small for the next one in the roll. Unless there is a sufficient supply of empty reels to start with, this means that the shortest reels should be shown last.

Beware also of the wide differences in the inside diameter of certain 400-foot spools for 16 mm. film. Some makes will accommodate up to 50 feet more than others, owing to this difference. If the feed spool is full, you may find that it will not all go on to the take-up spool.

Shows in Large Halls

When sub-standard film is to be screened before a really large audience, nothing must be left to chance. The 8 mm. gauge is only intended for viewing in the home, and any attempt to screen films of this gauge side by side with the larger gauges at a comparable screen size can only lead to disappointment and invidious comparisons. The tremendous degrees of enlargement involved show up the graininess mercilessly.

When 9.5 and 16 mm. films are screened before large audiences, the projector lamp should have a power of at least 750 watts. For special occasions such as these, you may be prepared to sacrifice some lamp life in the interests of increased brilliance. It is then permissible to overrun a lamp by about 10 per cent, using for instance a 200-volt lamp on a 220-volt mains supply. It is also worthwhile checking whether the mains supply is up to standard. Mains voltages are often as much as 10 to 20 per cent lower than their rated value.

Some projectors are fitted with adjustable or interchangeable shutters. As flicker is much less noticeable at long projection distances, it may be possible to adjust the shutter, or fit one with fewer blades, so as to increase illumination.

Maintenance

Projectors require regular lubrication to keep them in good order. The rule should be little and often rather than over-oiling at long intervals. Lubrication points are usually marked with red paint. Some advanced projectors have a centralized oiling system. When a projector is in regular use, oiling is advisable at given intervals, usually stated in the instructions. If stored away for a long period, lubricate again before using.

To avoid over-oiling, use a modern oil-can designed to deliver a drop at a time without surplus. One excellent type is designed to look like a fountain pen; another is modelled on a medical hypodermic syringe.

The motor brushes and commutator should also be regularly inspected and cleaned.

Film Storage

Whether films are kept on the projector spools provided by the laboratory or spliced together on larger reels, they should not just be put away in a drawer. Dust, heat and excessive humidity are the principal enemies of the film base and the emulsion.

Keep all spools of film in metal or plastic boxes. Title, place and date of exposure can then be written on the box, or on the special cellulose tape designed for writing on. With plastic boxes, the title can of course be written on a loose piece of paper and inserted with the film. Special cases are also available, designed to hold several cans of film, either in suitcase form or in the shape of a canvas bucket with a zip fastener at the top.

In Great Britain, the general humidity is usually sufficient to prevent films from becoming brittle without special attention to humidification. Very old black-and-white film stock may however be brittle, and special humidifying solution can be obtained. Some film cans are fitted internally with a special patch of absorbent paper to take this humidifier. If you cannot obtain these special solutions, use water with a few drops of glycerine added. Apply only a small quantity; too much will

cause the coils of the film to stick together and the remedy will be worse than the defect. The foregoing treatment should on no account be used with colour film.

Films should be cleaned from time to time, either with special film cleaning fluid supplied by several manufacturers, or with carbon tetrachloride. A silk cloth can be dipped in this fluid, then folded over the film and the film drawn through while gentle pressure is applied to both sides. Carbon tetrachloride evaporates rapidly, and the cloth should therefore be frequently re-wetted.

Special Systems

THE POPULARITY of the wide screen in the commercial cinema has led to the introduction of apparatus and lenses for the taking and projection of amateur wide screen films. The aim in all cases is to increase the relationship of width to height or the *aspect ratio* of the screen image, which is normally 1.33 to 1.

The commonest method, applicable to the 8 and 16 mm. gauges, involves the use of an optical *anamorphic* attachment on a normal camera and projector. Similar results are also obtainable by the use of apparatus designed to use a different frame area of film. But in this case only cameras and projectors specially designed for the purpose can be used.

Anamorphic Systems

The anamorphic system, originated by the French Professor Chrétien and popularized under the trade name *CinemaScope* in the commercial cinema, uses cylindrical lenses, prisms or mirrors, which compress or expand an image in one dimension only. A simple illustration of the result can be seen in a distorting mirror at a fun-fair.

A single attachment marketed under the trade name *Delrama* can be used for both taking and projection. It incorporates a pair of cylindrical mirrors, one convex and the other concave, and increases the aspect ratio to 2: 1. The attachment is fitted in front of the existing camera or projector lens.

In practice, an anamorphic attachment increases the horizontal field of view of the camera by 50 per cent and this must be allowed for when composing the picture. If the camera finder can be adjusted to the same horizontal acceptance angle

as the anamorphic attachment, it will be necessary to allow for the reduced height of the image, to correspond to the greater aspect ratio.

Owners of 16 mm. sound projectors can also obtain special lens attachments (in Great Britain *Ross Expandascope* 2X and *Vidoscope* Anamorphic 2X) enabling them to screen library copies of professional films shot by the CinemaScope process. These attachments are not intended for camera use.

Several manufacturers of amateur cine equipment are following the lead given by the professional *Vistavision* process, in which the cine frame itself has a larger aspect ratio, which is reproduced on the screen without recourse to anamorphosis.

Pathé-Duplex

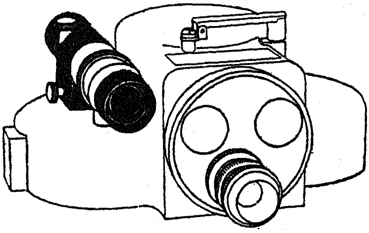
Pathé have introduced a special 9.5 mm. film known as Duplex and provided with double perforations in the centre. When loaded into the camera designed for the purpose, it can be exposed in either of two alternative ways at will.

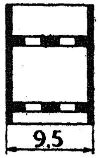
With camera held vertically, an image of normal dimensions is obtained, and can be projected normally.

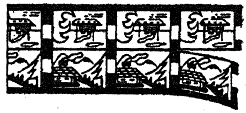
Alternatively, half the gate aperture can be masked and the camera turned on its side so that the longer side of the frame is horizontal. The film then runs horizontally through the camera and, as with double-8 film, only one half is exposed at a time. At the end of the run the charger is turned over to bring the other, unexposed, side opposite the gate aperture, for the second run. After processing, the film is split down the middle and joined end to end. But projection procedure is different from that with 8 mm. film: the film runs horizontally through the special projector, giving an aspect ratio of 1.6 to 1.

Super-Huit

A similar adaptation of a 16 mm. camera, involving masking half the gate aperture and holding the camera horizontally, has been carried out in France under the name *Super-Huit.* Special attachments are provided to enable the films to be shown on a normal projector.



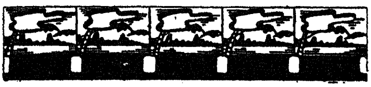


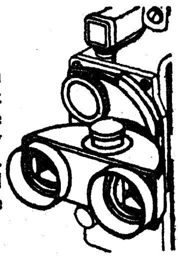


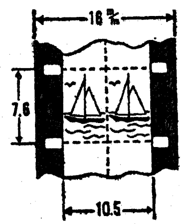
Above: The Pathe-Duplex wide screen system uses specially perforated 9.5 mm. film. The camera is held so that the film path is horizontal, and the longitudinal image covers one half of the normal 9.5 mm. frame area. The film is split after processing, and a special projector is required.

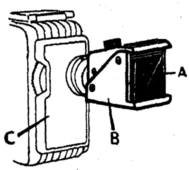
Above left: One French 16 mm. camera can either provide a normal aspect ratio picture, or operate as a wide-screen 8 mm. camera. For wide-screen operation the camera is held horizontally and half the gate is masked over. The film is then slit for projection as with normal double-8 stock.

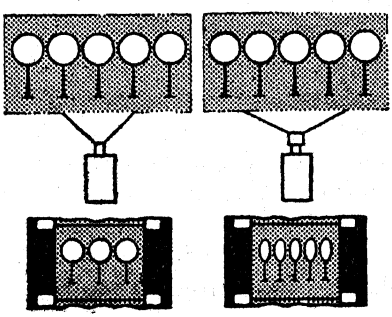
Right: Stereo films are obtained with a special twin lens attachment to fit certain makes of 16 mm. camera. The lenses project a pair of images side by side on to the normal 16 mm. frame area. A special lens attachment is also needed on the projector, and the audience wear polarizing glasses.











Left: Anamorphic wide-screen systems compress or "squeeze" the image in the horizontal plane only. The camera is seen fitted with a mirror anamorphic attachment. A. Optical system. B. Mount. C. Camera body. The same attachment is also used on the projector. With a normal lens the image on the film (*extreme left*) is a replica of the original. With an anamorphic attachment a circle appears as an ellipse, but a wider field is covered.

Panascope

Another French manufacturer has designed a special camera to take double-eight film so that it is exposed across the whole usable width of the uncut film (9.6 mm.), while the height remains that of the 8 mm. frame (3.51 mm.), giving an aspect ratio of 2.7 to 1. The film runs through the camera once only, and is not slit down the centre after processing. Though the film path is vertical in both camera and projector, both machines have to be specially designed to accept it.

Wide Screen Projection

When projecting a wide-screen picture it is necessary to bear in mind that, while the subject area is larger than normal, the projector illumination—unless the machine is specially designed for the purpose—remains constant. This means that a wide screen image will be less bright than one of normal aspect ratio, as a given amount of light is spread over an area perhaps 50 per cent larger.

With 8 mm. film this may be a serious handicap, as illumination is often barely adequate for a large screen image of normal dimensions. And to reduce the picture width in wide screen for the sake of brightness defeats the whole object of the system; it then leaves a "letter box" screen of inadequate height.

Exposures in Wide Screen Shooting

The Delrama anamorphic system has no colour and no visible linear distortion. The field of view is expanded in width whilst the height of the picture remains unaltered.

The manufacturers of the Delrama attachment recommend the use of one stop larger than normal when shooting. The extra picture area recorded on the film more than compensates for any light loss in the attachment itself when fitted to the *camera*; the purpose of the wider stop is to allow for the light loss that arises when the picture is *projected* on to a larger screen area than normal. Using a normal aperture with this attachment will result in a lack of brilliance in the projected picture.

The necessity of projecting a double image on the screen and providing means whereby each eye only sees the image intended for it, makes stereoscopic filming more complicated than snapshots with a still camera, which can be examined in a hand viewer.

Stereo filming equipment made by one manufacturer enables stereoscopic pairs of images to be recorded side by side on a single strip of 16 mm. film. A pair of lenses in a special mount, set at a separation corresponding to that of the human eyes, replaces the normal taking lens and the images formed by these lenses are brought together within the normal 16 mm. frame area by means of prisms. The camera finder is masked to indicate the field of view of the stereo image, which owing to the division of the normal frame area is necessarily taller than it is wide.

For the projection of stereo films the requirements are a special projection lens unit which polarizes the light in a different plane for each image, a metallized screen, and special polarizing glasses for each member of the audience. The projection lens and spectacles are supplied as part of the stereo outfit.

It should be noted that whereas stereo films of this type can only be shot with the camera for which the outfit is designed, the projection equipment is suitable for use on most 16 mm. projectors.

Adding Sound

SOUND BRINGS motion pictures to life. Facilities for adding sound are now available for users of all film gauges.

When associated with motion pictures, sound presents so many problems that it is best to approach it by easy stages. First consider the audience; second, the degree of synchronization required; third the existing apparatus. You can then decide what system will suit you best, and what additional equipment you need.

The Audience

To consider the audience before even starting to make a film may seem like putting the cart before the horse. But where sound is concerned, it is essential to work this way—unless of course expense is no object!

If you only aim to show your own films in the family circle, you will usually only need a single copy of each and of its sound accompaniment, and you will probably always use the same apparatus for screening it. For ordinary home use—where split-second synchronization (see below) is not required—the sound accompaniment can be provided by gramophone records or tape recorder. "Mood music" records are available commercially to suit the film.

The cost of a sound accompaniment on gramophone records or tape is not high, especially if you already have a gramophone or tape recorder. But if you hope to make a number of copies of a film for wider distribution, informal methods of this kind, where synchronization is obtained by manipulation of two separate units of apparatus, are no longer appropriate.

Where a film is required to reach a wide audience, make things easy for the projectionists. A cine club may have a standard procedure for playing sound on tape to facilitate exchange of programmes, but for other users you will have to record the sound on the actual strip of film beside the picture. This is expensive initially, but once done, synchronism is permanent.

There are two types of sound track that can be applied to picture film: magnetic (analogous to tape recordings) and (for 16 mm. film only) optical or photographic. A single film can take both types of track simultaneously; this is done when commentaries are required in different languages.

Synchronization

The average amateur interested in home showings will want to add some *background music* and *commentary*. The music is available on gramophone records, which can be transferred to tape for convenience of timing and cueing. But beware of copyright (page 274). The commentary is recorded on tape to fit the film *after* the latter has been edited.

A mains-driven tape recorder runs at a fairly constant speed. Adequate synchronization for these purposes is obtainable if a continuous check can be kept on the running speed of the projector, which with most silent models increases as the machine warms up. Several devices for this purpose are now on the market.

But for dialogue, with the characters actually seen on the screen as they speak their lines ("lip-synchronization") a tape recorder and silent projector, even when mechanically and electrically coupled, will no longer fill the bill. Sound on film is the only really satisfactory answer here. Costs are greater, but if dialogue is attempted, we can assume that the film, if successful, will have a wider appeal.

Dialogue sequences can be undertaken with the aid of 16 mm. equipment. They are either filmed and recorded simultaneously (a sound-proofed or *blimped* camera and electrical or mechanical coupling of camera and sound recorder are required), or are filmed silent and *post-synchronized* in a studio. There the actors speak their lines to match their own lip-

movements from the screen image as the film is projected to them. The projector and recorder are then linked.

A tape recorder has two main drawbacks when used for recording and reproducing dialogue. In the first place the tape is driven by friction, and liable to slip against the sound head, and it contracts and expands according to the humidity of the atmosphere. Finally, although the film is sprocket driven, the average silent projector has no device enabling a constant speed to be maintained. So true synchronization of the two instruments cannot be relied upon.

The Scope of Existing Apparatus

A cine enthusiast proposing to embark on sound will probably already own a cine outfit. This is likely to include a camera and ordinary silent projector; perhaps also a tape recorder. According to the outfit, here is what it will do, and what additional equipment is required for more ambitious work.

SCOPE OF SOUND EQUIPMENT

Sound Equipment or Film	*Projector*	*Scope of Combination*
Tape recorder.	All types.	Recording and accompaniment but not accurate synchronization with all three gauges.
Tape recorder and tape synchronizer; or synchronized tape recorder linked to projector drive.	8 and 16 mm. silent projectors designed for tape linking.	Recording and approximate synchronization of sound-short of lip-synchronization.
Striped film.	8 mm.; 9.5 and 16 mm. silent projectors with special magnetic attachment. 16 mm. magnetic sound projectors.	Recording and full synchronization.
Film with optical sound track.	9.5 and 16 mm. optical sound projectors.	Reproduction only with full synchronization (e.g. library prints; optical track cannot be added to silent films.)
Film with optical sound track and magnetic stripe.	16 mm. optical and magnetic sound projector.	Addition of extra sound effects or commentary to existing sound films in full synchronization.

This table applies to the addition of sound to edited prints of silent films. Recording sound *when shooting the picture* requires special procedures (p. 278).

Magnetic Tape

Magnetic recordings are normally made on ¼ inch tape. This is the article commonly used on domestic tape recorders. It is a plastic material with an iron oxide coating.

The normal practice with tape recorders is to make separate recordings along each edge of the tape, in the manner of filming with 8 mm. film. When the tape has been run through the reels are reversed and a second complete recording may be made in the other direction on the other side.

The standard reel of tape as used on most domestic recorders is 7 inches in diameter (the same as a 400 foot reel of 8 mm. film), and each end has a leader in a distinctive colour to facilitate identification of recordings.

A 7 inch tape spool will accommodate approximately 1,200 feet of tape of the normal type; and 1,800 feet specially thin long-play type.

The frequency range that can be reproduced depends on the speed at which the tape runs for recording and reproduction. There are four commonly used tape speeds: 1⅞ inches, 3¾ inches, 7½ inches and 15 inches per second. The slowest speed is used on office dictation machines; it gives adequate speech quality for this purpose, but is quite unsuitable for music. Music recordings at 3¾ inches per second are reasonably good; at 7½ inches per second they are very good. The 15 inches per second rate is used in broadcasting studios for the very highest fidelity.

The commonest speeds in domestic recorders are 3¾ inches and 7½ inches per second, giving 1 hour's recording or playback at 3¾ inches and 30 minutes at 7½ inches per second, per 1,200 foot spool.

Synchronizers (page 261) designed to keep a silent projector and domestic tape recorder in synchronism are usually designed for a tape speed of 3¾ inches per second.

Sound on Tape

When a tape recorder and silent projector are used in conjunction, the important point is to maintain constant speed

in the latter instrument. Most silent projectors are fitted with a series-wound universal motor, with speed control by variable resistance.

With this type of motor, constant speed is very difficult to obtain. As the projector warms up, the speed will increase; if the load varies, e.g. when a large amount of film has reached the take-up spool, the speed may drop.

Several manufacturers now market special synchronizing devices for coupling projectors to a tape recorder. There is a flexible drive from the projector to a special box containing a capstan which turns against an extra loop of the magnetic tape, formed between the sound head and the recorder take-up spool. This capstan, which bears against the tape (the speed of which is reasonably constant), causes the loop of tape to vary in size in the event of any variation in projector speed.

The extra loop of magnetic tape is also led round a pulley fixed on a swinging arm operating a resistance which is placed in circuit with the projector motor. Whenever the projector speed varies, the loop size varies accordingly and moves the resistance, which then corrects the motor of the projector and so restores synchronism.

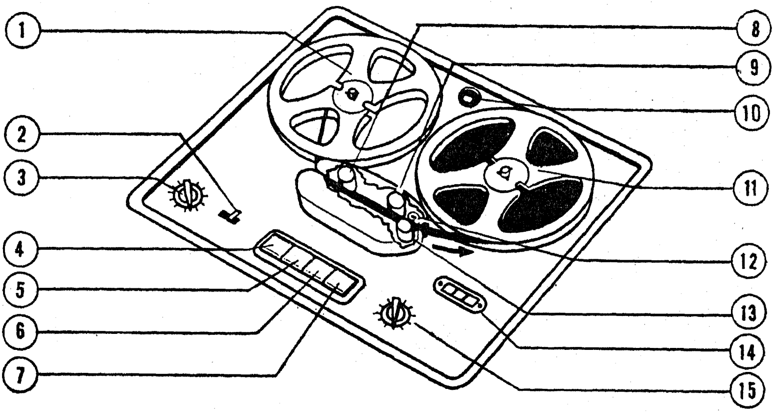
With a system of this kind, projector, synchronizer, and tape recorder must of course be placed close together in pre-determined positions. Appropriate synchronizing marks are required on both tape and film.

When this is done and the two machines started, the apparatus automatically maintains reasonable synchronism throughout the run of a reel of film.

A few projectors are also available incorporating a tape synchronizing device, and can then be used with a standard tape recorder.

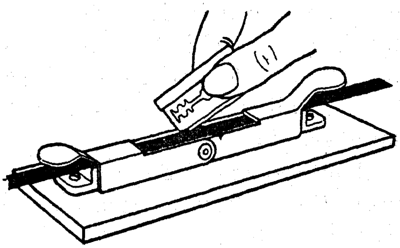
The same equipment is also used for recording the sound in the first place; but here special care is needed to avoid recording background noise from the projector itself which would completely spoil the effect.

Other types of projector-tape synchronizers are coupled in a similar manner to both instruments, but serve only to indicate whether they are correctly synchronized, and provide manual controls for applying any necessary correction.



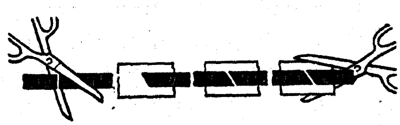
Typical tape controls. 1. Feed spool. 2. Speed change switch. 3. Volume control. 4. Record button. 5. Replay button. 6. Fast forward wind. 7 Fast back wind. 8. Erase head. 9. Record/playback head. 10. Recording level indicator. 11. Take-up spool. 12 and 13. Capstan. 14. Counter. 15. Tone control.

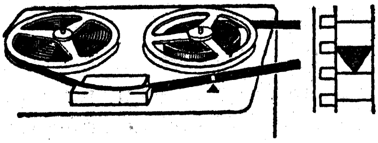
Single-track tape recorders record on and reproduce from the upper half of $\frac{1}{4}$ inch magnetic tape running from left to right. Standard speeds are multiples of $1\frac{7}{8}$ inches per second; $3\frac{3}{4}$ and $7\frac{1}{2}$ inches per second being the most generally used speeds. To use the other half track on a single-track machine, the tape spools are interchanged, as with double-8 cine film. Twin-track machines are designed to operate either track at will without the need to interchange spools.



Special splicers are available for tape editing. The two ends are trimmed diagonally, overlapped and joined with special adhesive. Special pressure-sensitized tape can also be used. The trimming tool must be non-magnetic, otherwise part of the recording may be accidentally erased.

Before editing a half-track tape recording, make sure that nothing of importance has been recorded on the other half-track.





When a sound accompaniment to a film is played back on a tape recording, cue marks are needed on both tape and film and must be set against fixed points on recorder and projector before starting.

Synchronizing Marks

With sound on tape, whatever method of synchronization is used, cue marks are required on both tape and film to ensure correct starting. With 16 mm. film, professional leaders, with numbers placed at 16 frame intervals, can be used. Otherwise a small hole can be punched in one frame, and this frame laced up in the gate opposite the aperture.

Tape can be cued by sticking a small piece of ¼ inch adhesive tape on the shiny side. Certain makes of tape recorders are now provided with a marker for this purpose, situated 115 mm. (4½ inches) from the magnetic sound head (on the outgoing side). They are designed for use in conjunction with the type of synchronizer mentioned on page 263.

Stroboscopes

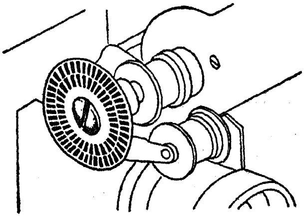
With an A.C. mains supply, a projector can be kept at constant speed by fitting a suitable stroboscope disc and controlling the speed manually so that the segments appear stationary.

On a 50 cycle supply a stroboscope fitted to an 8-toothed feed sprocket (one revolution corresponding to the passage of 8 frames through the mechanism), requires 100 segments (50 black and 50 white) for a speed of 16 f.p.s. and 66 segments (33 of each) for 24 f.p.s. The stroboscope can be illuminated by a small pilot lamp, preferably a neon, connected to the same supply.

The spokes of the disc will appear stationary when the projector is running at the speed for which the disc was designed.

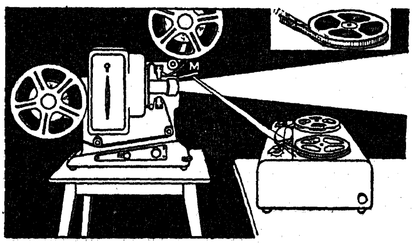
To calculate the number of segments required for a sprocket with any number of teeth, multiply the number of teeth by 6.25 for a running speed of 16 f.p.s., and multiply by 9.38 for 24 f.p.s.

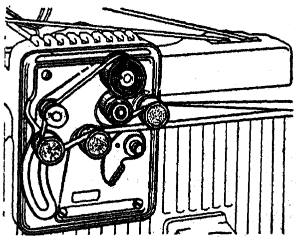
Another way of using a stroboscope is to mount the disc on a special idler pulley on the tape recorder and have it driven by a loop of tape. The segments are then observed by the light spill from the projector beam. The number of segments will depend on the diameter of the pulley, the speed of the projector



Left: A stroboscopic disc is an aid to maintaining constant speed in a projector. A 100-segment strobe disc can be fitted to a shaft that revolves once for every 8 frames of film, and observed by a lamp connected to 50-cycle A.C. mains. The segments will then appear stationary when the projector is operating at 16 f.p.s. For a speed of 24 f.p.s. 66 segments are required.

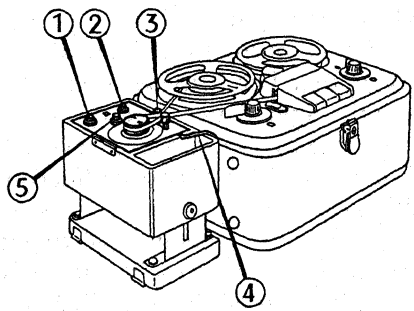
Right: Another way of maintaining synchronism between projector and tape recorder involves the use of stroboscopically striped tape. The light spill from the projector beam is deflected by the mirror M on to the tape. To maintain constant speed in the projector, adjust the speed control until the markings on the tape appear stationary. Variable speed projectors tend to run faster as they warm up.





Left: One 8 mm. projector has a built-in tape synchronizer. An extra loop of tape is taken from the recorder and led round an arm linked to a rheostat incorporated in the projector motor circuit. Variations in projector speed alter the position of the swinging arm, and this automatically adjusts the rheostat, thus maintaining regular running.

Right: Separate unit for synchronizing tape with projector. In this case the unit is placed beside the tape recorder. There is an electrical connection to the projector, which can be positioned elsewhere. This model has overriding controls for increasing (1) or reducing (2) projector running speed; an automatic start (3); electrical lead to projector (4); and manual start knob (5).



and of the tape, and the number of blades in the projector shutter.

Editing, Repairing and Splicing Tape

Tape can be edited just like film, though the inability to see the recording makes the work more laborious.

It can be joined by means of special splicers available from radio and photographic dealers. After the ends have been trimmed, the joint is made by applying special pressure sensitized tape, which only adheres when pressed into position. When using a splicer always work on the base (shiny) side of the tape.

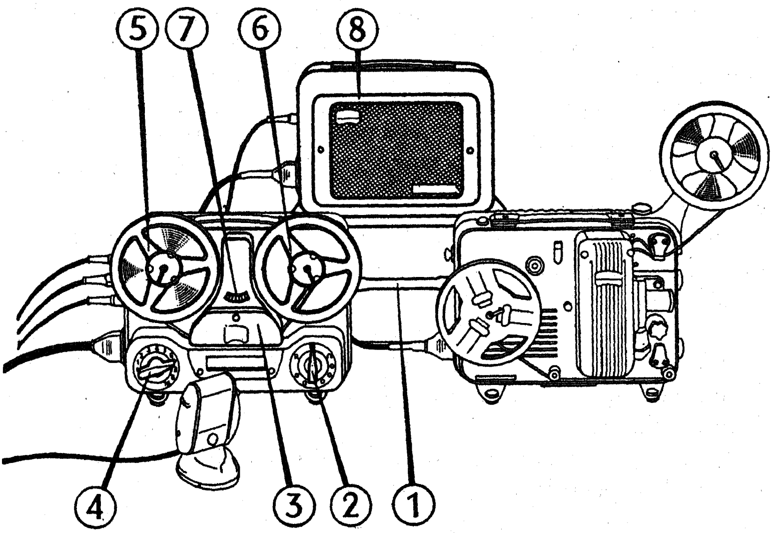
A splice, or a patch of adhesive tape on the base side, should be quite noiseless. Always ensure that the scissors used for tape editing are demagnetized. Any magnetic field will erase an existing recording and cause an audible "click" on reproduction. A stainless steel safety razor blade is a good tool for the purpose, as it is virtually non-magnetic.

Sound Stripe

An iron oxide coating or stripe similar to that applied to tape can also be added to the edge of the film itself; this facility is available for all three gauges. A magnetic track on film is more expensive than separate magnetic tape—the cost of striping is 1½d. per foot in Great Britain—but once the recording has been made, synchronization is infallible. As is the case with tape, a stripe recording can be erased and re-recorded whenever required.

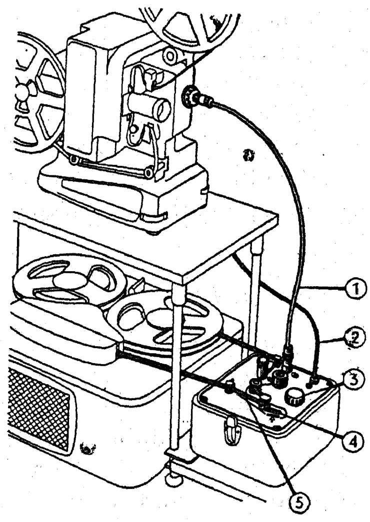
Film is normally striped after photographic exposure and processing. The stripe is applied to the side of the film that will face the light source on projection. According to the film stock used (negative-positive or reversal) this may be the emulsion or the base side; but stripe bonds to the surface equally well in either case.

To facilitate spooling of 16 mm. film, a second so-called balancing stripe is applied to the opposite edge of this gauge; but it is not used for recording purposes.



Above: One manufacturer supplies a complete 8 mm. sound film recording and projection outfit with tape recorder and separate loudspeaker. The recorder can record two separate half tracks and play them back simultaneously. 1. Recorder driving shaft. 2. Selector switch. 3. Recording and erase heads. 4. On/off switch and volume control. 5 and 6. 600 ft. tape spools. 7. Volume indicator. 8. Amplifier and speaker unit.

Right: The essential component of this 8 mm. sound outfit is a synchronizing unit placed beside a tape recorder. A capstan on the unit is driven by flexible shaft from the projector. Magnetic tape from the recorder passes over the capstan, and the relative speeds of tape and projector are automatically kept in step. 1. Flexible drive from projector to synchronizer. 2. Lead to projector motor circuit. 3. Knob for engaging tape with capstan. 4. Pivoting arm controlling projector motor speed. 5. Magnetic tape.



8 mm. Stripe

A single stripe 0.8 mm. wide is applied to 8 mm. film along the plain (non-perforated) edge. Recordings can be made and played back on special apparatus available for attachment to 8 mm. silent projectors. This takes the form either of a magnetic head fitted in conjunction with the feed spool; or of a sound unit placed below the projector, which accepts the film after it leaves the projector.

In the latter case, instead of being threaded on to the take-up spool in its normal position, the film is led from the take-up sprocket direct to the sound unit. The take-up spool is placed in position on the sound unit itself.

The projector can be operated at the normal rate of 16 f.p.s. However, the linear speed of the film is then so low that music quality is inadequate. It can be improved by running the projector at 24 f.p.s. But of course the film should then have been run at this speed in the camera.

9.5 mm. Stripe

With the 9.5. mm. gauge a stripe 0.9 mm. wide is applied along one edge of the film. It does not affect the picture format, which remains the same as for silent projection.

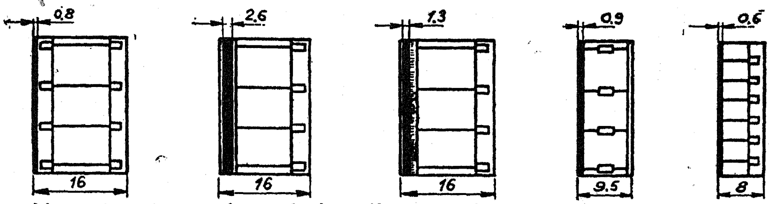
Satisfactory recordings of speech can be made in this gauge with the projector operating at the normal rate of 16 f.p.s. But the film must be run at 24 f.p.s. for quality to compare with that of a good domestic tape recorder.

16 mm. Stripe

There are several alternative arrangements possible with the largest gauge. These are edge stripe, half stripe, and full stripe.

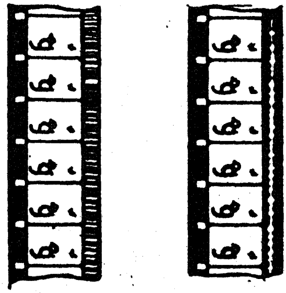
A 0.8 mm. wide *edge stripe* can be applied outside one row of perforations on double (silent) perforated film.

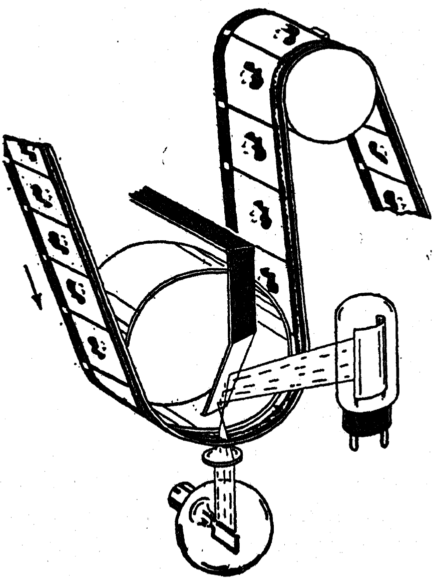
The usual procedure is to edit the film first, then have the stripe applied, and record commentary and music or effects in a projector designed for the purpose. The result is then reproduced in perfect synchronism on any magnetic projector.



Magnetic stripe can be applied to all gauges of film and provides a convenient method of adding sound. *Left to right:* Edge stripe on 16 mm. double perforated film; full stripe on single perforated 16 mm.; half stripe on 16 mm. film already bearing an optical track; standard stripe on 9.5 mm. and 8 mm. gauges.

The commonest form of sound track on 16 mm. film is known as optical or photographic, and occupies the unperforated edge of single-perforated stock. The sound is initially recorded on magnetic tape, then re-recorded on film, and printed alongside the picture. The sound is 26 frames ahead of the actual frame to which it corresponds, to allow for the distance between picture gate and sound head (*below*). Two types of sound track are available: variable density (*right*); and variable area (*extreme right*). Both reproduce equally well on standard equipment.





Optical sound head for 16 mm. The film comes down from the gate (*extreme left*) and passes under the sound drum, where a beam of light from the exciter lamp (*below*) is focused by a lens on the sound track. The variations in the sound track (*see above*) are transformed into variations of light intensity. After passing through the film, the light is reflected by a mirror inside the drum towards a photo-electric cell (*right*). This produces electric current proportional to the light striking it. The current is amplified and fed to a loudspeaker, thus reproducing the original sound. The standard running speed of 16 mm. sound film is 24 frames, or approximately 7.2 in. per sec.

Half-stripe 1.2 or 1.4 mm. wide can be added to 16 mm. *single perforated* stock which already carries an optical sound track. The increased width of track provides a better signal-to-noise ratio (i.e. the actual recording is much clearer and louder as compared with background noises) than in the case of the edge stripe. In this case, of course, the film will be already edited for the optical sound track before the magnetic track is added.

Single perforated film without optical sound track can be coated with a *full stripe* magnetic track 2.6 mm. (0.090 to 0.100 inches) wide, giving exceptionally good quality. This material is available from one manufacturer for camera use. To accept single perforated stock, the camera sprockets must have a single row of teeth, and also a single claw.

The draft British standard for 16 mm. full stripe stipulates that the sound shall be 28 frames ahead of the corresponding picture.

There are two main uses for 16 mm. sound stripe: (*a*) adding to a film originally planned as a silent film and consequently shot at 16 f.p.s.; (*b*) recording an additional sound track (e.g. in a foreign language) on a film that already carries an optical sound track. In this case the film will run at 24 f.p.s. as sound quality with optical tracks is inadequate at the slower speed.

16 mm. Optical Sound

Though magnetic *recording* is now universally employed in the preparation of sound films, most 16 mm. sound projectors are only designed for the *reproduction* of optical (or photographic) sound tracks.

For the 16 mm. worker who aims at the widest distribution of a sound film, a final optical track is therefore still best, although inferior to a magnetic track for musical reproduction. It is also the cheapest when many copies are needed.

The usual procedure when a final optical track is required, is to make the initial recordings on magnetic tape or film. Commentary, music and effects are usually recorded on separate tapes, then mixed or *dubbed* on to a master tape. The sound on

this master tape is then transferred to an optical track at one of the recording studios that specialize in this work and do it very efficiently.

In this way, all errors of timing or diction are overcome at the magnetic stage, when it is easy and inexpensive to make corrections.

The Optical Track

Single perforation 16 mm. stock is required to accommodate an optical sound track. The track occupies a width of between 0.070 and 0.072 inches on the unperforated edge, and may be of the variable area or variable density type, according to the design of the recording equipment. Both types of track reproduce equally well on standard optical sound projectors. The sound is 26 frames in advance of the picture to which it corresponds.

On holding a strip of optical sound film up to the light so that the image is the right way up and laterally correct, the sound track will be on the right hand side. If the film was originally shot on negative stock and you are looking at a print taken directly from that negative, the emulsion of both picture and sound track will be towards you (and towards the lamp when laced up for projection). But if the film was shot on reversal material, and the print was made from an intermediate duplicate (or *dupe*) negative, the emulsion will be on the other side.

When ordering an optical sound track from a 16 mm. recording studio, it is essential to state whether the camera original was negative or reversal stock as this affects the position of the optical track.

The optical track originates as a sound negative recorded down one edge of a separate strip of 16 mm. with nothing at all in the picture area; it is later printed as a positive on to the same strip of film as the final picture. The sound camera which records the track is adjusted to run forwards or backwards, according to whether the final print will have the emulsion towards or away from the projector lens which, of course, makes all the difference.

Sound Royalties

A royalty is payable when an optical track is recorded by Western Electric, R.C.A. Photophone and British Acoustics systems, to cover the use of patented apparatus. All other systems are royalty free.

Sound from Gramophone Records

Where synchronization of sound and picture is not important, gramophone records are suitable for background music.

A long lead will of course be needed between the record player and loudspeaker so that the latter can be placed near the screen. When separate turntable, amplifier and loudspeaker units are used, the electrical lead between the first two should not be longer than about 4 feet. The connexion between amplifier and loudspeaker can be of any desired length.

An automatic record changer is of little value for film accompaniment purposes, as obviously the changes of record cannot be timed to coincide with the changes of film reel. On the other hand, a dual turntable record-player is an obvious advantage. When separate volume controls are fitted, records can be faded in and out, and mixed at will.

When making a selection of records, manipulation will be greatly simplified if they are all designed for the same speed.

Selected passages from 78 r.p.m. records can be cued by marking with grease pencil as the needle reaches the desired place. This method cannot be used if a sapphire needle is used in the pick-up; nor is it suitable with L.P. microgroove records. The procedure here is to make up a special ruler to fit over the centre of the turntable and extend radially outwards. It is then marked at the point opposite the desired passage of the record.

Copyright in Gramophone Records

It is an infringement of copyright to dub or re-record *ordinary commercial* gramophone records on to tape, or to play them in public.

Special "mood music" and sound-effects recordings are available at the studios that specialize in 16 mm. sound record-

ing. Such recordings can also be purchased outright. In this case a royalty is payable, usually to the Sound Film Music Bureau, 29 Maddox Street, London, W.1. Special concession rates are available to bona-fide amateurs if application is made through either the Institute of Amateur Cinematographers or the Federation of Cinematograph Societies.

The Commentary

Modern magnetic recording equipment makes it almost fatally easy to add commentary to a film. But even the most casual-sounding commentary requires a great deal of preparation.

Words and phrases which read perfectly well as literature often *sound* clumsy; therefore rehearse the proposed commentary *out loud* again and again to ensure that the text puts the ideas across without being either trivial or stilted.

The major problem in commentaries is to ensure that you do not merely duplicate in words what is already evident from the image on the screen. This is particularly likely to happen with impromptu commentaries where the speaker has only the screen image to guide him and there has been no time to undertake research or look up some facts relevant to the picture, but not immediately apparent on the screen.

Ideal Proportions

A film, even a sound film, is primarily a visual medium; and the pictures should largely explain themselves. If they do not, the fault lies with the maker of the film. It is therefore a mistake to cram too much commentary into a film. A commentary is an important adjunct to films; but it cannot replace the picture. Otherwise the film becomes merely an illustrated lecture.

A sound radio commentator has to keep going all the time; if he does not, listeners may think that their sets have broken down. Do not try to emulate him.

Suggested proportions of commentary and music are two-thirds and one-third of the screening time respectively. Many amateurs will be prepared to dispense with music altogether, and leave periods of silence between the commentary sections.

A commentary should not be too sparse, either. After a long period of silence, the reappearance of the commentator's voice without warning on the sound track will come as a surprise. And anything in the nature of a surprise, unless deliberately intended, is unprofessional and bad technique.

Timing the Commentary

As the film runs through the projector at a constant rate (normally either 16 or 24 f.p.s.) a commentary can conveniently be timed by ascertaining the number of syllables that can be spoken while a given length of film runs.

Generally at a comfortable, deliberate rate of speech, such as is suitable for film commentary, it is possible to enunciate about 21 syllables in 5 seconds. This corresponds to the passage of 1 foot of 8 mm., and 2 foot of both 9.5 and 16 mm. film, through a projector operating at 16 f.p.s.

If the projector is running at 24 f.p.s., half as much film again passes through: 1½ feet of 8 mm. and 3 feet of 9.5 and 16 mm.

Often it is more convenient to find the ratio of syllables to *footage*. As a simple rule of thumb, an average for 9.5 and 16 mm. film is 10–11 syllables per foot at 16 f.p.s., or 7 syllables per foot at 24 f.p.s. With 8 mm. film twice as many syllables can be accommodated.

If the commentary is delivered very fast or very slowly, the number of syllables in a given footage may vary by 20 per cent.

The Recording Session

The first thing to ensure when recording a commentary in the home is that the microphone does not pick up extraneous noise, particularly from the projector itself.

If possible, take the script and the microphone into a separate room, and arrange for the picture to be projected either through a glass ~~door~~ or port-hole. Alternatively, use adjacent rooms lea~~ding on to the same~~ corridor, have the projector in one and project the picture into the corridor on a screen or the wall. You then watch it from the other room and record the commentary accordingly.

The room chosen for the recording should be as non-resonant as possible. Drape all large unbroken surfaces with curtains or blankets to minimize echo.

A good average distance from speaker's mouth to microphone is 12 inches. Be careful to avoid rustling the pages of the manuscript. Adopt the radio announcer's technique of using thick paper and having the pages in a loose pile, one on top of another, on a table or desk. On coming to the end of a page, lift it up without turning over, and lay it down, right way up, to one side.

Maintaining Constant Level

It is very important that all sound recording for a given film should be made at the same level of volume and under identical acoustic conditions. If the level varies, the projectionist will be obliged to adjust the volume control; and unless he knows the film intimately, he will be all at sea.

Most amateurs will improvise a recording studio in any convenient room. In practice this makes it very difficult to reproduce the same set of conditions on another occasion so as to obtain a recording of identical quality. Therefore, the best course is to record all the commentary on one occasion.

Sound Procedure in Brief

Here is a summary of the steps for adding a commentary, music and effects to a film shot as a silent film.

Steps 1 to 6 apply to all magnetic recording processes (tape and stripe) for home showing (single copy, any film gauge) or wider distribution (multiple copies, 16 mm. only).

1. Edit the picture.
2. Draft the commentary.
3. Read the commentary aloud while the picture runs.
4. Rewrite the commentary and re-edit the picture as needed.
5. Select the music and effects (optional for home shows).
6. Final stage for home shows: record the commentary (and —home shows only—mix effects, if any) while the picture runs.

The following additional procedure is required for 16 mm. sound on film (magnetic or optical) when a number of copies are required.

7. Prepare the music and effects on separate magnetic tapes.

8. Prepare a master tape by mixing the commentary (step 6) with the tape or tapes from step 7.

The following final stage is used for a final 16 mm. magnetic track.

9. Transfer the master tape to magnetic stripe. (N.B. When a number of copies are required, each requires individual sound treatment.)

For a final 16 mm. optical track use this procedure as an alternative to step 9 above.

9. Transfer the master tape to the optical track.

10. Match the optical track to the picture by running both tracks "double headed" on a suitable projector.

11. Cut the picture and sound negatives to match the editing under step 10.

12. Have the *married print* made by a laboratory.

(N.B. As the sound, like the picture, is photographically recorded, printing of both is simultaneous and automatic.)

Direct Sound Recording

Magnetic tape and magnetic stripe on film both lend themselves extremely well to the addition of sound to a film that is already edited for screening. But when it is desired to record picture and sound simultaneously, many further problems arise.

Many years ago an American manufacturer marketed a 16 mm. camera able to record picture and optical sound track simultaneously. It met with little success, and the reason is not far to seek. Sound reproducing equipment on projectors invariably accepts the film at a point remote from the intermittent movement of the picture gate. In 16 mm. sound apparatus the sound is 26 frames ahead of the picture to which it corresponds. If, therefore, sound and picture are recorded simultaneously on the same strip of film, it is impossible to cut up this strip for editing purposes without causing a jump in either picture or sound, or both.

Synchro-Pulse

Though most amateurs will only wish to record sound after the picture is edited, the simultaneous recording of sound and picture is commonly undertaken in professional 16 mm. work. Ordinary unsprocketed ¼ inch magnetic tape can be used for this purpose by the synchro-pulse system. This requires an electrical attachment in the camera which reproduces the sprocket holes in the form of pulses on one side of the tape.

The recorded sound is later transferred on to film (magnetic or optical). The pulses are fed on to a cathode ray tube, together with pulses from the sound camera, thus enabling the tape and film to be brought into synchronization visually.

It is also possible to obtain very good synchronization between 16 mm. film and ¼ inch tape if both tape recorder and camera can be driven by a pair of specially designed matched motors with electrical interlock.

Magnetic Film

An alternative to the synchro-pulse system, frequently used in professional recording, involves the use of special recording apparatus taking 16 mm. sprocketed film with a magnetic coating.

Film in both camera and recorder runs at the same speed (7.2 inches per second, equivalent to 24 f.p.s.), perfect synchronization from frame to frame is obtainable by electrical interlock, and editing greatly simplified.

The foregoing systems are essential where absolute synchronization is required. That is the case when lip movements of speakers are visible on the screen, or when incidental noises clearly associated with the picture are involved, e.g. hammer blows and the like.

If an ordinary tape recorder is used to record sound while the picture is being shot without special provision for synchronization the sound is likely to wander or "creep" noticeably out of synchronization when the two are played back together. Nothing destroys the illusion of a film more than an error of synchronization in sound and picture.

Ordinary tape recordings are perfectly satisfactory where background effects only are required, but for dialogue a great deal of work at the editing stage will be required to obtain an acceptable result.

The Clapper Board

When picture and sound are shot together, it is essential to provide a simultaneous visible and audible cue mark at the beginning of each shot. This facilitates matching of film and tape at the editing stage.

The professional practice is to write details of the shot on a so-called clapper board, which is a slate fitted with a hinged arm. The device is then held in front of the camera, camera and sound equipment are started, and the arm is snapped shut. The exact moment when this takes place can then be seen on the film and heard on the tape.

Faults and Remedies

Black-and-White Films

Fault	*Cause*	*Remedy*
1. Thin, light image.	Over-exposure, caused by too large aperture setting.	Refer to exposure table and camera instruction book. Use exposure meter.
2. Dark, dense image: alternatively greyish image showing pronounced graininess.	Under-exposure, caused by too small aperture.	See No. 1 above.
3. Scratches.	(*a*) Film chafing against camera body.	(*a*) On spool loading camera, form smaller loops; on magazine loading camera, clean the baffles, make sure that the film runs freely into and out of the magazine.
	(*b*) Dirt in camera or projector gate, caused by loose particles of film, or protrusion in the metal.	(*b*) Stop the projector and check whether the part of the film not yet screened is also scratched. If it is, the camera is at fault; otherwise the projector is scratching the film. Clean the camera or projector gate, as the case may be. In the case of any rough metal protrusion, return apparatus to the manufacturer.
4. Unsharp pictures.	(*a*) Faulty focusing.	(*a*) Measure distances accurately when using wide apertures, and particularly with a telephoto lens. Use a rangefinder.

Fault	Cause	Remedy
	(*b*) With fixed focus lens: close-up attachment not used for close shots; alternatively not removed for distant shots.	
	(*c*) Interchangeable lens not screwed right home.	
	(*d*) Lens mount out of adjustment.	(*d*) Have the camera checked by an expert.
5. Pictures partially unsharp.	(*a*) Uneven pressure of camera pressure plate.	(*a*) *and* (*b*) Have the camera (or projector) checked by an expert.
	(*b*) Faulty alignment between lens and film in either camera or projector.	
6. Pictures unsharp at the edges.	Projection lens of insufficient covering power.	Arises with certain very wide aperture projection lenses of short focus: check focusing and refer to the manufacturer.
7. Pictures slightly unsharp and greyish.	(*a*) Dirt or condensation on camera or projector lens.	(*a*) Clean regularly.
	(*b*) In winter, condensation on projector lens or condenser.	(*b*) In winter "acclimatize" projector when bringing from cold into warm room, and run it before show begins.
8. Blurred and jumpy screen image.	(*a*) Loss of projector film loops	(*a*) Check the positioning of film on feed sprocket.
	(*b*) The projector pressure plate has jumped out of engagement or is not pressed fully home.	(*b*) Check the pressure plate for register and spring pressure.
	(*c*) Projector shutter out of adjustment (in this case the film itself will be sharp if examined directly).	(c) Refer to an expert.
9. Jerky movement in subject.	Bad choice of camera angle for rapid moving subject; camera panned too rapidly.	Never film at right-angles to a fast-moving subject; choose a distant position, at about 45 degrees so that the subject comes towards the camera; and follow the movement with the camera. Swing the camera slowly, if possible on a tripod, with pan and tilt head, and run the camera at 24 f.p.s.

Fault	Cause	Remedy
10. Fogged pictures.	(*a*) Camera not loaded in the shade. (*b*) Too much leader unwound when loading. (*c*) Camera opened before the whole film had run through.	Load camera before leaving home. When loading outdoors turn your back to sun and stand in the shade. Do not leave spools or magazines lying about unprotected in sunlight. Put them back in their cans or in a bag immediately.
11. Fog extending to the perforation holes, and along the whole length of the film.	(*a*) Outdated film. (*b*) Buckled camera spool or defective magazine.	(*a*) Check expiry date on film package. (*b*) Check that spool flanges are parallel by using loop of film as distance gauge. Make sure that the magazine lid is a good fit, or held in position by adhesive tape, also that no screw is missing.
12. Bright, semi-circular dots on the picture.	Direct rays of the sun reaching lens (when shooting towards the sun, or with sunlight on water).	Keep lens-hood permanently in position on the lens. Otherwise, shade lens with hand or stand in the shade of a tree.
13. Moon-shaped white mark in the image.	Shot taken with wide-angle attachment close to a sheet of water and towards the sun.	Shield the camera lens by standing in the shade or use special lens-hood.
14. Normal pictures, but image partly masked by a dark mass.	Foreground object inadvertently included in field of view (finger, hand shielding lens, balcony, parapet etc.)	Practice holding the camera. Check length of the lens-hood used for cut-off. Never mount very long-focus telephoto lens immediately adjacent to a wide-angle lens in a turret camera.
15. Indistinct or irregular picture margin: black foreign bodies or hairs.	Dust in camera or projector gate.	Check both instruments frequently: if fault lies in camera, film exposed prior to its detection is irretrievably spoiled.
16. Small black or yellow dots all over picture area.	Defective processing.	No remedy: shoot film again if possible.
17. Torn perforations.	Failure of camera take-up mechanism, causing jamming.	When loading the camera, check that the film is correctly in position on

Fault	Cause	Remedy
		feed sprocket (if any) and in gate; also that it is firmly attached to take-up spool. Individual torn perforations in 9.5 mm. film can be repaired by patching.
18. 9.5 mm. film: Central area of the picture lighter than the two sides, the effect extending from perforation hole to perforation hole.	During processing developer circulated more rapidly between perforations and caused partial over-development.	No remedy.
19. 8 mm. film: first half normal, second half completely blank.	Spool not turned over for the second run.	Never use a plain take-up spool; ensure that it carries an inscription, such as: "Film on this spool only half exposed."
20. Film partially or completely blank.	(*a*) Lens cap was not removed.	(*a*) Remove lens cap if the camera is in frequent use. Only replace it when the camera is stored away for a considerable time.
	(*b*) Film loaded wrong way round.	(*b*) Refer to loading instructions (page 20).

Colour Film

Fault	Cause
General	
1. Thin, light picture, with pale and washed-out colours.	Over-exposure; too large aperture.
2. Dark, dense pictures, overall bluish tinge.	Under-exposure; too small aperture used.
3. Incorrect colour rendering of certain parts of the subject, especially with close shots.	Subject illuminated by light of different colour, or lit by reflection from coloured objects outside field of view.
4. Overall false colour rendering.	Film out-dated, or stored in excessive humidity or heat.

Fault	Cause
5. Orange-coloured tinge appearing irregularly and intermittently at edge of picture.	(*a*) Fogging resulting from loading in bright light. (*b*) Film allowed to come uncoiled on spool. (*c*) Spool flanges buckled. (*d*) Film dispatched for processing without enclosing in protective meta can.
Daylight	
6. Green tones in distant shots rendered as blue-green; excess blue in high altitude shots, at the seaside, on snow and in overcast weather generally.	Excessive ultra-violet radiation. Use ultra-violet filter.
7. Excessive blue-cast in shadow areas, e.g. in shots where shadow areas are important, as in street scenes with low sun elevation.	Use ultra-violet filter referred to above (see film manufacturer's literature).
8. Overall blue-green cast in the film.	Artificial light emulsion film used in daylight without conversion filter.
9. Overall red-orange cast throughout the film.	Shots exposed too early or too late in the day.
10. Overall yellow cast.	(*a*) Yellow filter for black-and-white film inadvertently left on camera lens. (*b*) Film used and stored in excessive heat. (*c*) Exposed film left too long before processing.
11. Overall abnormal colouring of film.	Inadvertent use of colour filter designed for black-and-white film.
Artificial Light	
12. Overall red-orange cast.	(*a*) Artificial light type film used with ordinary incandescent lamps, or lamps of a type other than that recommended by the manufacturer. (*b*) Mains supply voltage below that required for overrun lamps. (*c*) Daylight type film used without special conversion filter.
13. Overall colouring rendering good, but certain parts of the image excessively blue.	Part of the scene inadvertently illuminated by daylight. When exposing indoors by photoflood light, it is essential to exclude all daylight from the room, or filter it to the correct colour temperature.

Fault	*Cause and Remedy*
1. Motor does not run.	Broken circuit. Check the mains lead; also the motor brushes; motor switch defective; if projector fitted with a fuse, check this.
2. Motor turns slowly.	(*a*) Projector too cold. (*b*) Insufficient lubrication. (*c*) Step-down resistance inadvertently used when not required. (*d*) Incorrect voltage tapping on universal motor.
3. Motor runs but the mechanism remains stationary.	(*a*) Broken transmission belt. (*b*) Still picture clutch in operation.
4. Film runs backwards.	Projector switched to reverse or rewind position. After rewinding, immediately replace feed and take-up belts in correct positions for projection; or switch over to forward running.
5. The lamp does not light.	(*a*) Filament burnt out; insert spare lamp. (*b*) Bad contact in lamp switch or socket. (*c*) Fuse blown.
6. Insufficient illumination on projection.	(*a*) Lamp adjustment faulty. (*b*) Lamp designed for higher voltage than that of actual mains supply. (*c*) Dirt or condensation on mirror, condenser or lens. (*d*) Transformer wrongly connected or resistance wrongly adjusted.
7. Loss of lower film loop.	(*a*) Incorrect lacing. (*b*) Excessive tension on take-up belt.
8. Take-up spool does not revolve.	Insufficient tension on belt or belt not passing over take-up pulley.
9. Film winds irregularly on to take-up spool.	Spool flanges buckled.
10. Film will not run.	(*a*) Film base hardened and buckled with age. (*b*) Use of excess cement in splicing, causing buckling at one point.
11. Projector claw tears perforations.	Incorrect lacing at feed sprocket. Ensure that film is correctly seated at this point.

Fault	*Cause and Remedy*
12. Screen image out of focus.	After lacing up, pressure plate not pressed fully home on film.
13. Screen lights up, but no image visible.	Projector lens pulled out too far from gate; push back and regulate focusing.
14. Screen image needs constant refocusing.	(*a*) Reel composed of films of different manufacture, or of mixture of negative-positive and reversal film. (*b*) Play in lens mount.
15. Framing control requires constant readjustment.	Film shot on cameras with differing frame line.
16. Unsteady screen image.	(*a*) Film particles adhering to the gate. (*b*) Projector claws or shutter out of adjustment.
17. Film scratches.	(*a*) Particles of film adhering to the gate. (*b*) Worn gate, and/or defective chromium plating. (*c*) Rollers of feed sprocket jammed.

Indexed Glossary

ANAMORPHIC LENS. Special optical unit placed in front of camera and projection lenses, designed to increase horizontal field of view without affecting the vertical dimension of the picture 255

ANIMATED VIEWER. Apparatus for convenient inspection of film during editing, providing enlarged frame image. Film can be run in either direction, and stopped at will . . . 223

ANIMATION. The art and technique of creating movement on the screen from static drawings or objects 203

APERTURE. Adjustable diaphragm on lens which regulates the amount of light transmitted. Also used to refer to the setting of this diaphragm 24

A.S.A. Abbreviation of American Standards Association, commonly relating to the U.S. standard of film speed measurement. Co-ordinated with the British B.S. system . . . 62

ASPECT RATIO. Shape of the screen image expressed in terms of width relative to height. Normally this is 1.33 to 1, but with an anamorphic attachment the ratio can be increased to 2.55 to 1 255

BACK PROJECTION. System of projection of films or slides on to a translucent screen from the rear. Used both in film studios, to simulate a real background, and for screening of films when projector cannot be located behind the audience . . 176

BIG CLOSE UP (B.C.U.). Very close shot, taking in only a small area, such as part of the human face, to draw attention to minute details 36

BLIMP. Case enclosing camera or projector to reduce mechanical noise 261

BLOOPING INK. Black opaque ink for painting out areas on film and particularly over splices in a sound track to render them inaudible (can also be used for wipes) 185

B.S.I. Abbreviation of British Standards Institution. Commonly refers to standardized method of film speed measurement. The B.S.I. (or B.S.) and A.S.A. systems are co-ordinated . . 62

CAPSTAN. Drum or roller pulling tape through a magnetic recorder 264

CAST. Any excess—generally unwanted—of a particular colour in a colour image 88

CELLS. Transparent sheets on which animation drawings are traced for cartooning 214

CHARGER. Type of simple film cassette for loading and unloading a camera in daylight 54

CINEMICROGRAPHY. Preparation of motion picture films shot through a microscope. Used in medical films and for other special purposes 205

CLAPPER BOARD. Type of take-board, with details of the take chalked on it, for direct recording of sound films. While the board is being filmed, a hinged flap is banged down on it to make synchronizing mark on the sound track 280

CLICK STOPS. Device on modern camera lenses, providing positive stop at each marked aperture 23

CLOSE-UP (C.U.). Shot in which the camera is, or appears to be, very close to the subject. A human close-up would include head and shoulders only 36

COLOUR TEMPERATURE. Measure of the colour quality of a light source with a continuous spectrum. It is expressed in degrees Kelvin. The lower the colour temperature, the richer light is in yellow and red rays; the higher the temperature, the richer it is in blue rays 102

COMPLEMENTARY COLOURS. Colours which, when projected together as light beams on to a neutral surface, produce white light 89

COMPOSITION. Arrangement of the subject in the finder according to the requirements of the action, and aesthetic considerations 37

CONTINUITY. Easy transition from one shot to the next and from one sequence to the next without awkward breaks or discrepancies 115

CONTINUITY SHOT. Shot taken after a film is completed, for insertion where required to maintain continuity . . 229

CREDIT TITLES. Printed list of the cast and technical unit responsible for a film. Can appear at beginning or end of the film 158

CREEP. Difference between the tape speed and capstan speed in a magnetic recorder, due to the tape slipping slightly on the capstan. Commonly causes loss of synchronization . . 262

CROSS-CUTTING. Alternation from one scene to another in editing so that two or more events are represented as taking place simultaneously 227

CUT. Instantaneous transition from one shot to another without fade or dissolve 48

CUT-AWAY. Shot that temporarily draws spectators' attention away from the main action; e.g. a reaction shot. Apart from dramatic uses, a cut-away is also useful for bridging continuity 116

CUTTING COPY. Positive print used solely for editing purposes. The original is maintained intact as a source of subsequent prints. Also known as a *work print* 61

DEPTH OF FIELD. Area within which a subject can move towards or away from camera without image becoming noticeably unsharp. Depth of field increases as a lens is stopped down to smaller aperture and is greatest with a lens of short focal length 27

DIAPHRAGM. Adjustable stop used for controlling lens aperture, so regulating the amount of light reaching film. Most cameras have a diaphragm of continuously variable iris type using a set of thin metal blades 24

DIFFUSER. Optical glass with special pattern, or piece of thin cloth placed before camera lens to soften contours of a subject 198

DIN. German standard specification. In photography, usually refers to system of film speed measurement . . . 62

DIRECTOR. Person responsible for the creative side of film production. He translates the script into a film and is in charge of the actual shooting 123

DISSOLVE. Gradual transition from one shot to another, the second being superimposed on the first at point of transition. Also known as a *lap dissolve*, or a *mix* 182

DOUBLE-EIGHT. Film stock 16 mm. wide but with twice as many perforations as normal 16 mm. film. After processing it is slit and joined end to end to form a double length 8 mm. film for projection 50

DUBBING. Re-recording of sound, e.g. from disc on to tape or film, or from one tape to another 278

DUPE, DUPLICATE. Picture negative prepared from a positive original. Used for making further prints when original picture was filmed on reversal stock 60

EDGE-NUMBERING. Numbers printed at every foot along the edge of 16 mm. negative film. These numbers print through to the positive and facilitate cutting of the negative to match the edited cutting print 61
EDGE-STRIPE. Magnetic stripe applied outside perforation holes (usually on 16 mm. film). See also *half stripe* and *full stripe* 270
EDITING. Process of assembling the component shots of a film into their final order and then cutting them to their final length 220
EFFECTS BOX. Bellows or box-like attachment to fit in front of the camera lens. Acts as a lens-hood and holds masks (mattes) at various distances in front of the lens for special effects . 184
ERASE HEAD. Device for removing sound recorded on magnetic tape or stripe 263
EXCITER LAMP. Lamp used to scan the sound-track in a projector; it activates the photo-electric cell . . . 235
EXPOSURE LATITUDE. Range of differing exposures (in practice usually lens aperture values) within which an acceptable image is obtainable. With black-and-white film, latitude may extend to as much as two stops either side of correct exposure. With colour film latitude is usually restricted to half a stop either way . 86
EXTERIOR. Scene filmed out of doors . . . 29
F-NUMBERS. Range of figures used to indicate the amount of light transmitted by any lens at different aperture settings . 24
FADE. Gradual darkening of a shot on the screen to complete blackness (fade-out) or the reverse effect (fade-in). As a transition, a fade suggests passage of time 178
FADING SOLUTION. Dye solution for producing home-made fades on processed reversal (or positive) film . . . 180
FAST MOTION. Trick effect obtained by running the camera at a lower speed than normal and projecting at normal speed 188
FIELD OF VIEW. Area embraced by camera lens or viewfinder 26
FILTER. Coloured disc of glass or gelatine placed in front of camera lens to modify rendering of colours with either black or white or colour film 69
FILTER FACTOR. Factor by which exposure must be multiplied (i.e., lens aperture opened) when a filter is in use. For instance, a factor of 2× indicates a doubling of the exposure (i.e. open aperture by one stop) 75
FIXED FOCUS. Camera lens, usually of short focal length, permanently focused on a given distance (often hyperfocal distance) to provide maximum sharpness at average filming distances 28

FLAP-OVER TITLE. Title change effected by turning a card rapidly, so that the reverse side is shown whilst the camera is running 172

FLASH. Brief shot consisting of a few frames that remains on screen for a faction of a second. Frequently used in dramatic sequences to heighten tension 43

FLASHBACK. Transition from present to past tense in film narrative, often conveyed in the form of a character's recollections.

FLASH FRAME. Over-exposed initial frame of shot, resulting from inertia in camera mechanism and appearing on the screen as a light flash. Normally removed during editing . . . 128

FLICKER. Failure of persistent vision; the picture is not evenly bright all the time 234

FLOAT. Projection defect often resulting from insufficient pressure of pressure pad in camera gate. Screen image appears to "float" up and down 196

FLUTTER. Effect produced by very quick variations in the speed of a sound recording medium. Similar to wow, but occurring as much faster irregularities 260

FOCAL LENGTH. Distance between the optical centre of a lens and the film plane, when the lens is focused on infinity. Focal length determines the scale of the image 23

FOCAL PLANE. Position of the film in the camera. Sometimes indicated on the outside of the camera body by a reference mark for measurement of camera-subject distance in close shots . 23

FOG. Veil effect caused by action of unwanted light on film. Can be caused by careless loading of camera in bright light. May also appear in stale film used after expiry date 20

F.P.S. Abbreviation of frames per second, indicating running speed of film in camera or projector. Normal speed for silent films is 16, for sound films is 24 f.p.s. 129

FRAME. Single picture in the series printed on a length of cine film; also the rectangular shape which bounds the viewfinder field of the camera and hence the picture on the screen . . 128

FRAME LINE. Narrow line or area between two frames of motion picture film. Position of frame line relative to perforation holes depends on exact adjustment of the camera intermittent mechanism. There is no standard frame line position, and if a film is shot on different cameras, any variation will make constant adjustment of projection framing necessary . . . 128

FRAMING. Adjustment of the gate mask on a projector to

obscure the film perforations. Also known as *racking*. The term is sometimes used as a synonym for composition . . . 248

FULL STRIPE. Magnetic stripe occupying full width of unperforated edge of 16 mm. single perforation film . . 272

GATE. Component in camera and projector which holds each frame flat and momentarily still behind the lens . . 128

GAUGE. Measure of film width. The three gauges normally used by amateurs are 16 mm., 9.5 mm. and 8 mm. . . . 50

HALATION. Halo effect sometimes seen in the neighbourhood of very bright subjects. Caused by the reflection of scattered light from the back of the film base 64

HALF-STRIPE. Half track magnetic coating applied to a 16 mm. sound film to cover half the optical sound-track. Either the optical or the magnetic track can thus be reproduced at will 272

HIGH-ANGLE SHOT. Shot filmed with camera in elevated position, aimed downwards at the subject. Often used to make subject appear insignificant 38

HUMIDIFIER. Moistened pad in film cans to prevent the film from becoming too brittle 68

HYPERFOCAL DISTANCE. Distance from the camera to the near limit of sharp focus when the lens is focused on infinity. If the lens is focused on the hyperfocal distance, depth of field extends from half the hyperfocal distance to infinity . . 27

INDUCTION MOTOR. Electric motor running at a speed largely but not entirely determined by the mains supply frequency. Commonly used on tape recorders and sound projectors . 263

INSERT. Close-up of letter, newspaper headline, clock face, etc., which, by its very nature, can be filmed at any time and inserted in previously exposed material 115

INTERCUTTING. See *cross-cutting*.

INTERIOR. Shot filmed indoors, often with artificial light 95

INTERMITTENT MECHANISM. Film transport mechanism which advances the film one frame at a time in the camera or projector 128

IRIS DIAPHRAGM. See *diaphragm*.

JACK. Male connecting plug, commonly used for input and output on tape recorders and sound projectors . . . 263

JAMMING. Camera mechanism failure, often due to defect in take-up mechanism causing film to pile up and block the mechanism 20

JUMP CUT. Jarring transition from one short to another in which, for example, an actor's position appears to change suddenly 230

KELVIN DEGREES. Units on the absolute scale of temperature. Equal to degrees centigrade plus 273. Named after a notable physicist and used for measuring colour temperatures of light sources 102

LAP DISSOLVE. Obsolete name for *dissolve*, q.v.

LEADER. Strip of film at the beginning of a spool used for loading or threading into the camera or projector. The length may vary from 3 to 5 feet 20

LEVEL SYNCHRONIZATION. Placing of synchronizing marks on separate strips of 16 mm. picture and optical sound film, so that the record of a sound appears immediately opposite the corresponding picture. (As opposed to *printing synchronization*, q.v.) 277

LIP SYNCHRONIZATION. Synchronization of sound with film, accurate to a fraction of a second, so that visible lip movements exactly correspond to the sound 261

LIVE RECORDING. Recording of dialogue and other sound made while a scene is actually being filmed. Also known as *direct recording* 278

LOCATION. Natural setting, usually out of doors and away from the studio, where the shots for a film are taken . . . 123

LONG SHOT (L.S.). Shot in which the camera is, or appears to be, at a considerable distance from the subject. A human figure would occupy less than one third of the height of the picture 35

LOW ANGLE SHOT. Shot obtained by placing the camera low down and aiming upwards. Subject can be made to look either menacing or absurd 38

MAGAZINE. Special type of film cassette for the instantaneous loading or unloading of a camera in daylight. Often incorporates part of the intermittent mechanism 54

MAGNETIC RECORDING. Sound recorded as variations in magnetization of particles in an iron oxide coating on film or tape 263

MAIN TITLE. Opening title bearing the name of the film 158

MARRIED PRINT. Print of a sound film (usually 16 mm. optical sound), incorporating both picture and sound track. Obtained in laboratories by printing picture and sound negatives separately and in succession on to same positive strip . . 278

MASTER RECORDING. Complete sound record, usually on magnetic tape, from which the final recording is later prepared 278

MATTE. Mask placed in front of camera lens to blank out part

of the scene. Available in standard shapes, e.g. binoculars, keyhole, etc. 184

MATTE BOX. See *effects box.*

MEDIUM SHOT (M.S.). Shot which in effect is midway between a *close-up* and a *long shot,* q.v. 36

MIX. See *dissolve.*

MIXING. Combination of sounds or recordings so that they can be reproduced simultaneously through one reproducing system 278

MONTAGE. Film sequence designed to suggest rapid passage of time and/or events, using technique of rapid cross-cutting or a succession of dissolves 227

NARROW GAUGE. Films and apparatus not of the standard 35 mm. type, i.e. 8, 9.5 and 16 mm. 50

NEGATIVE FILM. Film stock, available only in 16 mm. gauge, which is developed to a negative (as in still photography), and from which separate prints must be made for projection. Initially much more expensive than reversal film, negative stock becomes economic when many prints are reqired . . . 61

NEUTRAL DENSITY FILTER. Neutral grey filter used to reduce the light passing through a lens without affecting its colour. Used either to avoid over-exposure, or to reduce depth of field by permitting the use of a larger aperture 75

NON-SYNC. Recording reproduced without provision for precise synchronization with the film 261

OPTICAL RECORDING OR TRACK. Sound photographically recorded on the unperforated margin of 16 mm. film. The track modulates the light passing through it from a special lamp and the impulses are electrically converted into sound. Available also on library prints of 9.5 mm. film . . . 272

OPTICALS. Special effects, e.g., dissolves and fades, made by processing laboratories on an optical printing machine after the scenes have been photographed normally. Available for 16 mm. film 182

PAN. Pivoting movement of camera, while running. . 44

PANCHROMATIC. Black-and-white film able to reproduce the colour values of a natural subject in the correct relative tones of neutral grey. Most black-and-white films for camera use are panchromatic 14

PARALLAX ERROR. Error in camera centring due to displacement of finder relative to camera lens. Results in the finder showing a slightly different view from that recorded on the film. Of significance only at distances below 6 feet . . . 33

PERFORATIONS. Holes in cine film by which it is driven through camera and projector. 8 mm. film is perforated down one side at intervals of 3.81 mm.; 9.5 mm. is perforated in the centre; 16 mm. film is perforated on both sides (silent film) or on one side only (sound film), both at intervals of 7.62 mm. . . 50

PERSISTENCE OF VISION. Inability of the human eye to separate individual images appearing in rapid succession. This makes the illusion of movement possible in motion pictures 234

PHOTO-ELECTRIC CELL. Light-sensitive device used both in exposure meters and sound heads of optical cine projectors 78

PHOTOFLOOD. Incandescent lamp designed to emit specially bright light for brief periods through over-running . . 96

PLAYBACK. Shooting of motion picture to accompaniment of previously recorded music, which is then matched to the picture at the editing stage. The converse of *post synchronization* . 261

POLARIZING FILTER. Filter designed to eliminate unwanted reflections from non-metallic surfaces in black-and-white and colour photography. In colour photography polarizing filters can render the sky tone darker. Also used in projection of stereoscopic films. There each image is projected through an appropriate filter, and the spectators wear spectacles with glasses adjusted so that each eye only sees the image intended for it. . . 74

POST-SYNCHRONIZATION. Recording of dialogue and other sound after production so that it matches the action and lip movements in the film 261

PRESSURE PLATE OR PAD. Camera and projector component holding the film accurately in the focal plane. It forms part of the gate 128

PRINTING SYNCHRONIZATION. Placing of synchronizing marks on separate 16 mm. picture and optical sound negatives, so that the latter is 26 frames in advance of the former, as required for projection. See also *level synchronization* . . . 277

RECORD-PLAYBACK HEAD. Electro-magnet which serves either to produce or detect local magnetization on tape or striped film 263

REEL. Spool of film or tape. A typical standard film projection spool holds 400 feet of 16 mm. film, giving a running time of 16 minutes at 16 f.p.s., or 11 minutes at 24 f.p.s. A standard 7 inch diameter tape reel holds 1,200 feet of ¼ inch magnetic tape . 240

REGISTRATION. Accurate positioning of separate objects or drawings designed to be filmed in superimposition or succession 214

REVERSAL FILM. Film designed for processing so that it

produces a positive image on the original strip used in the camera. Most amateur filming is done on reversal stock . . . 58

REVERSE MOTION. Recording of scene with camera held upside down for trick effect; and in animation. The film is then turned round at the editing stage, and when projected presents the picture in reverse motion. Not recommended for 8 mm. work, as the image is laterally reversed on projection . . . 190

ROLL-UP TITLE. Lettering attached to drum with horizontal axis, which when revolved makes text appear to pass up the screen. Also known as *running title* 170

ROUGH CUT. Preliminary rearrangement of motion picture shots in editing, before their lengths are accurately adjusted 220

R.P.M. Abbreviation of revolutions per minute, commonly referring to speed of gramophone records, e.g., $33\frac{1}{3}$, 45, 78 r.p.m. Camera and projector speeds are measured in frames per second (f.p.s.), tape speeds in inches per second 274

RUSHES. Lengths of processed film viewed before editing, immediately the film is returned from the processing laboratories 220

SCENARIO. Obsolete term for *film script* . . . 123

SCENE. Part of action which may be recorded in a single shot 125

SCHEINER. System of film speed measurement, formerly common on the Continent of Europe 62

SCRIPT BREAKDOWN. Analysis of film script in terms of scenes with the same locations, sets, properties, etc. These will then be filmed in sequence, and rearranged in the order of the shooting script at the editing stage 125

SERIES-PARALLEL SWITCHING. Method of connecting lamps for easy change-over from series to parallel wiring. In the series position, lamps, if identical and connected in pairs, burn at reduced intensity and have prolonged life; in parallel position they give full intensity 100

SETTING (LENS). Clearance between rear flange of lens and film plane in camera. Standard setting (type D) for 8 mm. cameras with interchangeable lenses is 0.484 (12.29 mm.). Standard setting (type C) for 16 mm. camera is 0.690 inches (17.52 mm.). The type C mount is also used on many 9.5 mm. cameras . . 138

SEQUENCE. Phase in the development of the film story, roughly equivalent to the chapter in a novel . . . 123

SHOOTING SCRIPT. Story of the film in its final form, containing details of action, shot by shot, together with setting and camera positions 125

SHOT. Part of the action recorded on film with the camera running, or appearing to run, continuously . . . 125

SIGNAL/NOISE RATIO. Relationship of sound level on reproduction (in a tape recorder or other sound equipment) to extraneous noises due to hiss and other unwanted reproduction sounds 276

SLOW MOTION. Apparent slowing down of action on the screen achieved by filming at an increased camera speed and projecting the film at normal speed 187

SOUND DRUM. Large roller carrying the film in a projector at the point where the sound track is scanned . . . 235

SOUND HEAD. Component of projector or magnetic tape reproducer which reproduces the magnetic or optical sound recording 235

SPLICING. Process of joining up strips of film by means of film cement. For best results and rapid work a suitably designed splicer is used 220

START MARKS. Marks on film and disk or tape enabling the picture to be started in close synchronization with the sound 264

STOCK. Motion picture film before exposure . . 50

STOP MOTION. Procedure of stopping the camera (while mounted on a firm support) in the middle of a take, making some change in the scene, and continuing shooting. Used for sudden appearances or disappearances of actors or objects, and similar trick work 189

STRIPE. Magnetic coating applied to one or both margins of a film and used for recording sound 268

STROBOSCOPIC DISK. Rotating arrangement of dark and light radial lines which appear stationary when illuminated by light flickering at a related frequency. Used to maintain projector and tape recorders in synchronism 266

SUB-TITLE. Explanatory title commonly incorporated in a silent film either to replace dialogue or to bridge a gap in the story 170

SUBTRACTIVE COLOUR PROCESS. Principle of colour photography in which any particular colour is formed by the absorption or subtraction of its complementary colour from white light. E.g. yellow is produced by filtering out the blue rays from white light, yellow therefore equals white minus blue. All modern motion picture colour film reproduces colours by the subtractive principle 64

SUPERIMPOSITION. Recording of separate images on the

same strip of film. Requires accurate registration of images, and back winding of camera between shots 195

SUPPLEMENTARY LENS. Positive lens placed before camera lens for filming at close distances 145

SYNCHRONIZATION. Accurate co-ordination between sound and its relevant picture 266

SYNCHRONOUS MOTOR. Electric motor which runs at a speed determined solely by the mains supply frequency. Used in high quality projectors and tape recorders . . . 263

TAKE. One recording of a shot. One shot is often filmed several times and the best take selected 125

TAKE-BOARD. Board on which scene numbers are recorded and filmed before each take. This information is of great use to the editor when subsequently identifying and assembling the scenes 280

TAKE-UP. A reel or core winding up film or tape after it passes through camera, projector, or magnetic recorder mechanisms 15

TAPE. Narrow plastic or paper ribbon, commonly ¼ inch wide, coated with iron oxide and used for magnetic recordings . 263

TELEPHOTO LENS. Lens that reproduces the image on a larger scale than a normal focus lens without moving the camera closer to the subject 26

TEMPO. Impression of pace in a film created by the relative length of each shot within a sequence and by the speed of the action within a shot 232

THROW. Distance from the projector to the screen . 239

TIME LAPSE. An extension of fast motion, with single frames being exposed at long intervals to show movement that is normally too slow to observe visually (e.g. the growth of a plant, opening of a flower, etc.). Usually requires complex timing apparatus . 193

TITLE. Lettering of any kind, either explanatory or in the form of dialogue in silent films 158

TRACKING SHOT. Shot from a camera that is travelling forwards, sideways or backwards. Often used to follow moving subjects. A similar, but not identical, effect is produced by a variable focus or zoom lens with a fixed camera position . . . 47

TRAILER. Blank film at the end of a reel in either camera or projector 20

TREATMENT. Story of a film in its preliminary form visualized in pictorial terms, but not yet worked out in technical details 123

TURRET. Rotating or sliding mount on the front of a cine camera carrying 2, 3, or 4 lenses and sometimes also their associated view-finders. Enables the desired lens to be quickly brought into position 140

TWIN-TRACK RECORDER. Magnetic tape recorder in which less than half the width of the tape is used at once so that interchange of the spools enables a second recording to be made on the same length of tape 263

ULTRA-VIOLET RADIATION. Invisible rays, by which all films are strongly affected. Causes haze in distant shots and bluish cast on colour film 73

VARIABLE AREA RECORDING. 16 mm. optical sound recording in which the track consists of clear and opaque areas, the complementary widths of which vary from point to point along the track 273

VARIABLE DENSITY RECORDING. 16 mm. optical sound recording in which the light absorption of the constant width track varies from point to point 273

VARIABLE FOCUS. Lens of continuously variable focal length, commonly described as a *zoom lens*. The term should not be confused with *focusing*, which is the opposite of *fixed focus* . 140

VIGNETTING. Dark border surrounding image, often caused by use of excessively long lens hood on camera . . . 153

WIDE-ANGLE LENS. Lens of shorter focal length than normal, covering a large subject area 26

WIPE. Transition from shot to shot in which a line appears to pass across the screen pushing off the first shot and revealing the second shot 183

WORK PRINT. See *cutting copy*.

WOW. Slow wailing effect produced by uneven movement of a recording medium during sound recording or reproduction. Often caused by uneven transmission in the motor drive . . 263

ZOOM. Change in apparent distance between camera and subject, effected by a variable focus lens, during actual filming. See *variable focus* 140

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